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ABSTRACT

A study was conducted to develop a cost management control procedure to assist Navy managers in making decisions about initial training development and implementation in surface ship acquisition programs. Objectives were (1) develop and illustrate a cost management control procedure for centralized collection, storage, and control of cost data for commercially developed initial training programs; (2) develop an instrument for cost data collection compatible with existing training requirements directives and proposed cost management control procedures; and (3) identify and examine noncost management considerations affecting procedures for selecting training alternatives. A subjective rational approach, based on case history analysis, was used. Data bases were established from cost data derived from training device acquisition programs and noncost management data derived from major system equipment acquisition programs. Nine training device course cost proposals were selected for in-depth analysis. A computer-based cost management control procedure was developed to assist in selecting the most efficient initial training alternative, preparing initial budgetary estimates, and performing contractor cost proposal evaluations. (Appendixes include illustration of a cost estimation procedure for Navy developed initial training, summary of cases studied, data collection instrument for contractor developed training course, cost management control procedure data summary, and cost data for various initial training courses.) (Author/CSS)

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TAEG Report No. 68

A COST MANAGEMENT CONTROL PROCEDURE FOR INITIAL TRAINING IN SURFACE SHIP ACQUISITION PROGRAMS

Roger V. Nutter
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Training Analysis and Evaluation Group

May 1979

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This is the second of two reports addressing the alternatives available for the development of Navy initial training courses; i.e., contract, Navy, or Navy/contractor developed. The first, TAEG Technical Memorandum 77-5, Precommissioning Training, July 1977, presented a technique for estimating the cost of Navy developed initial training courses and recommended case studies of a representative sample of surface ship initial training programs to further explore the available alternatives. Based on this recommendation, five major acquisition programs were selected for study. Results of these

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studies indicated the need for a standard procedure for maintaining and disseminating historical cost and management initial training data. As a result of the nine training device course programs sampled, a computer based cost management control procedure was developed. The procedure is designed to assist program managers in selecting the most efficient initial training alternative, preparing initial budgetary estimates, and performing contractor cost proposal evaluations. Validation and refinement of the procedure is required.

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SECTION I

INTRODUCTION

Navy managers are increasingly concerned about the escalating cost of initial and follow-on training, particularly for sophisticated systems and equipments. In 1976, the Navy successfully employed a relatively new approach for the development and presentation of precommissioning (PRECOM) training, at an apparent cost avoidance. That approach involved the substitution of Navy developed and implemented training for a similar program provided by a contractor. TAEG Technical Memorandum 77-5 (Cordell, Nutter, and Miller, 1977) documented a study which examined this approach in terms of its applicability to other PRECOM training development and implementation programs. Because of data limitations, however, the value of such general application could not be determined.

The study reported here was initially designed to obtain additional data by which to validate the feasibility of the Navy developed and implemented PRECOM training approach. It was also designed to develop specific cost and management guidelines that would aid an acquisition manager in selecting the most effective means to accomplish initial training.[1] The generation of specific guidelines was dependent upon the development of a comprehensive data base, consisting of Navy and contractor initial training cost and management information. This data was to be acquired through case studies of representative Navy acquisition programs. Although substantial effort was made to identify relevant and complete case histories (refer to appendix B for list of commands and activities contacted), required data were either not available or were incomplete. Major factors contributing to the unavailability of appropriate data included:

- the dispersion of responsibility and accountability across/within organizations
- a lack of clarity in and agreement on roles and responsibilities of initial training organizations
- the lack of a central point for storage of historical cost and management data
- the lack of a standard format for presentation of detailed cost data
- the existence of exceptions to established policy in the sequence/timing of management milestones.

[1] Initial training is defined as that training provided to the operating crews of a selected number of initially acquired units, test and evaluation crews, and prospective instructors for follow-on training. PRECOM training is a type of initial training. For this report, the term "initial training" is used because it is more inclusive. A complete listing of definitions and acronyms used in this report is contained in appendix A.

The lack of data caused the present study to be redirected to the development of a cost management control procedure for contractor developed and implemented initial training programs; i.e., the centralizing, for management purposes, of the records of cost expenditures for each acquisition program. Despite the volume of commercially prepared initial training packages, no standard procedures for cost comparison among contractor submissions exists. The proposed cost management control procedure has the added capability of being used in conjunction with the cost estimation technique recommended for Navy developed courses (see appendix C) to permit quantitative cost comparisons between the two approaches.

During the conduct of this study, the investigation was expanded from consideration of only PRECOM training to include examination of case studies representing other kinds of initial training. The use of this more inclusive term reflects Naval managers' concerns with costs of all such programs rather than only those associated with precommissioning details.

PURPOSE OF THE STUDY

The purpose of this study was to develop a cost management control procedure to assist Navy managers in making decisions about initial training development and implementation in surface ship acquisition programs. Three specific objectives were established to satisfy this purpose:

1. Develop and illustrate a cost management control procedure for the centralized collection, storage, and control of cost data for commercially developed initial training programs. Implementation of this procedure would aid managers in developing preliminary initial training budget estimates, evaluating contractor cost proposals, and comparing contractor developed initial training costs with Navy developed initial training costs for certain similar courses.

2. Develop an instrument for the collection of cost data which is compatible with existing training requirements directives and the proposed cost management control procedures.

3. Identify and undertake a preliminary examination of major noncost management considerations that would affect the use of the proposed cost management control procedures in making specific selections among initial training alternatives.

STUDY APPROACH

A subjective rational approach centered about analyses of case histories (refer to appendix D for summary of cases studied) was used to meet study objectives. Two types of historical data were required:

- Cost data describing all contractual costs and labor effort (man-hours) required in contractor developed initial training programs

- Noncost management data describing the major program events and management actions of representative initial training programs from the time

of the Operational Requirement (OR) to CNET acceptance of follow-on training responsibility.

A single data base that included both cost and noncost management data of acceptable quality was not available; consequently, two independent data bases were established for the investigation. The cost data were derived from training device acquisition programs and the noncost management data were derived from major system/equipment acquisition programs.

COST DATA. The cost data base derived from training device acquisition programs was not adequate for the extraction of cost estimation standards for operational hardware/system acquisition programs. However, these data did suffice to establish and demonstrate the feasibility of the proposed procedure. The procedure will require validation using a comprehensive data base drawn from operational hardware/system acquisitions prior to future use.

The cost data were obtained from Naval Training Equipment Center (NAVTRAEQUIPCEN) documentation. Thirty training device course cost proposals were examined and nine selected for in-depth analysis on the basis of their completeness. The data were used to:

- define requirements for specific cost labor estimation procedures
- establish major contract cost categories
- identify primary labor classifications
- design appropriate cost data collection instruments
- examine cost data input and output format requirements
- illustrate the utility of the cost management control procedure
- identify procedure applications and areas requiring additional development.

NONCOST MANAGEMENT DATA. Since there was no central repository of documented noncost management data, the majority of useful case study information was acquired through discussions with knowledgeable personnel; examination of available fragmented records supplemented these discussions. Fourteen programs were identified as candidates for in-depth case study; only five of these fourteen programs contained sufficient data to warrant serious review. Even though the data were not complete for even these five cases, they were sufficient to allow preliminary identification and description of noncost considerations affecting the cost management control procedure.

In some instances, sufficient data existed to permit the development of milestone charts which indicated the relationship between major required training decision points and required acquisition decision points. These milestone charts (see appendix D) were used to examine the question of standardization of procedures among acquisition programs and to identify areas requiring development of sound management decision guidelines for initial training development and implementation.

STUDY LIMITATIONS AND CONSTRAINTS

The fundamental limitation of this study is the data base from which concepts and conclusions are derived. Whereas the data base is adequate for the development of an initial cost management control procedure, it is not of sufficient size or validity to derive reliable cost estimation statistics. The cost figures and related calculations presented in subsequent sections of this report are for illustrative purposes only and should not be used as the statistical basis for budget estimation, contractor proposal evaluation, or initial training alternative comparison. Substantial quantities of additional comprehensive cost and management data are required to completely develop the procedure examined in this investigation. Acquisition of such data will require the comprehensive study of the complete history of numerous acquisition programs.

In addition to the limitation just identified, the following constraints affected the conduct of the study:

- Only all-contractor or all-Navy developed/implemented initial training programs were examined. No appropriate case history reflecting a combined effort by Navy and contractor personnel to develop and implement an initial training course was identified.

- Data for this study was acquired only from surface ship acquisition programs. Thus, preliminary findings should be restricted in their application to similar programs.

ORGANIZATION OF THE REPORT

In addition to this introduction, three major sections and eleven appendices are provided. Section II describes the development of a procedure for cost management control of contractor developed initial training programs, illustrates concept utility and application, and identifies future required development/validation requirements. Section III identifies and describes major noncost considerations that affect the use of the procedure in making initial training selection decisions. Section IV contains study conclusions and recommendations.

Appendices A through C provide, successively, a compendium of useful definitions and acronyms, a list of commands and activities contacted, and an illustration of a cost estimation procedure for Navy developed initial training. Appendix D contains a summary of each of the cases studied. Appendix E is a copy of the data collection instrument for contractor developed initial training courses and appendix F provides a computer printout of the data used in developing the cost management control procedures. Appendices G through K present cost data for various initial training courses, using the format described in the report.

SECTION II

A COST MANAGEMENT CONTROL PROCEDURE FOR COMMERCIALLY DEVELOPED INITIAL TRAINING PROGRAMS

This section of the report presents a discussion of the steps undertaken in the development of a cost management control procedure for budget estimation, cost estimation, and program evaluation for commercially developed initial training programs; provides insight to the application and utility of the procedure through illustration; and identifies areas requiring future effort. Development of the procedure included:

- identification and development of an acceptable data base
- organization of data by major contractual cost categories
- analysis of labor category elements
- design of cost data collection instrument for contractor developed initial training programs
- examination of procedure utility and data presentation formats
- illustration of procedures for comparative analysis of initial training costs
- application of the cost management control procedures to major acquisition programs
- identification of required future development effort.

DISCUSSION

Initial efforts to identify and acquire necessary cost data revealed a requirement for an initial training cost management control procedure to include an unsophisticated, user oriented, standardized technique for developing preliminary budgetary estimates and a standard method of evaluating contractor proposed initial training costs. Further examination of this requirement resulted in the definition of specific design considerations for the procedure. These considerations include the following:

- central storage of initial training cost data
- ready accessibility
- minimum data input requirements
- cost efficiency
- data update capability
- representative of all types of contractor conducted initial training
- user oriented.

Numerous concepts have been proposed as tools to improve the management processes and overall efficiency of Government-sponsored programs. Based on these concepts, models have been proposed that are theoretically and mathematically correct; often, however, these models are not implemented or used because of (1) the lack of a valid requirement, (2) a lack of interest, (3) technical complexities, (4) difficulty in accessing, and/or (5) excessive implementation costs. Basic considerations in the development of any model should include the user's background, the user's specific requirements, and ease of utilization. These considerations were paramount in developing the cost management control procedure that follows.

DATA BASE

As was previously stated, major operational system/equipment cost data were inadequate. Therefore, it was necessary to use cost data contained in contractor training device cost proposals submitted in response to various types of training device solicitations. Of particular relevance to this study were those portions of the costs for development and implementation of training device maintenance and operator training courses. The types and categories of development effort and attendant costs required for the development of training device courses closely parallel the effort and costs required for the development of initial training programs for operational systems/equipment. However, it should be noted that the amounts of effort and cost will vary between operational system/equipment initial training courses and those for training devices. Moreover, costs used for training devices represent proposed contractor costs, and these may not reflect final negotiated costs. For purposes of developing the procedure, neither of these two factors is considered serious. However, it is important to reiterate that dollar and hourly figures derived from the nine cases examined are computed for illustrative purposes only. They should not be used in estimating future course requirements costs, even though data describing major cost categories, labor classifications, and development effort appear reasonable and may generalize to hardware acquisition programs. However, before generalizing training device initial training data to operational systems, more data must be examined.

DATA ORGANIZATION

To organize the data, major contractual cost categories were first identified. The percent of each category relative to the total contract cost was then computed. The six categories identified were:

- labor
- overhead
- general and administrative (G&A)
- profit
- material
- travel.

These categories are shown in figure 1 as mean percentages of the total mean course costs of the nine cases. Mean percentages were calculated by determining the average cost per category per instruction hour for each cost proposal and dividing by the average total contract cost per instruction hour. The percentage cost per category was established by dividing the average category cost per instruction hour by the average contract cost per instruction hour. The classification of funding categories appears reasonably accurate in terms of expected percent distribution of funds.

A seventh classification was originally considered for inclusion as a separate funding category. This classification would have reflected miscellaneous type costs that did not conveniently fall within the six funding categories identified. Available data indicated the occurrence of this "Other" category funding to be infrequent and, when present in cost proposals, to be less than two percent of total training contract cost. For this reason, that category has not been included here.

ANALYSIS

The analysis which follows is based on the costs per instruction hour and percentages of total costs shown in figure 1.

Labor and Overhead categories comprise over 70 percent of the total contract cost. Overhead is normally established as a function of labor cost; the percentage varies with the contractor. Thus, of the six funding categories, labor, with its influence on overhead, has the single greatest influence on the total cost of developing and implementing a training course. Each of the remaining four categories represent small percentages of the total contract cost. Moreover, they are reasonably predictable and measurable. It is the labor category where the least exact training course cost estimation and cost evaluation procedures exist. For these reasons, emphasis has been placed on examination of the labor funding category and its component elements.

The cost of labor is determined by four basic elements: (1) labor hourly rates, (2) labor classification, (3) labor effort, and (4) labor distribution. Labor hourly rates by labor classification are variable, yet predictable, and require no explanation. An identification and standardized listing of labor classifications is found in table 1. The 10 classifications were derived from a review of contractor cost proposal data and are typical of what is required for training course development and implementation. This listing may require revision when a larger sample of initial training contract data is submitted to analysis.

TABLE 1. STANDARD LABOR CLASSIFICATIONS FOR INITIAL TRAINING COURSE DEVELOPMENT

Labor Classification	
Manager/Supervisor	Senior Instructor
Training Specialist	Technical Writer
Engineer	Instructor
Senior Engineer	Illustrator/Draftsman
Typist/Clerical	Technician

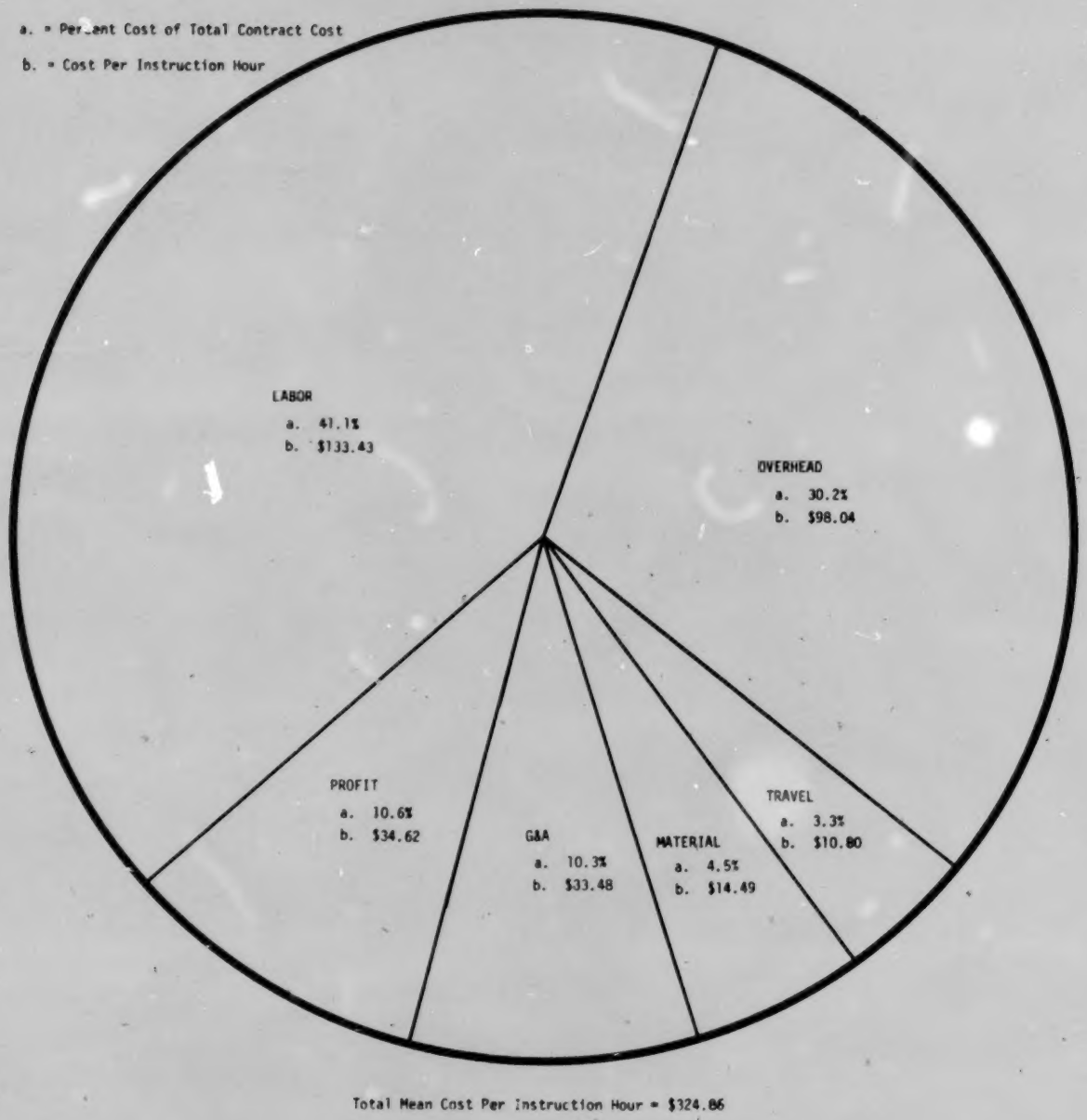

Figure 1. Cost Per Instruction Hour and Percent Cost of Total Contract Cost by Major Contract Cost Category

The elements of labor effort and labor distribution are derived from data collected from course review. They could not be quantitatively examined in this study until an appropriate format had been developed for their organization and summary. To provide for this requirement, a data collection instrument was designed and a trial computer program developed for investigative purposes.

DATA COLLECTION INSTRUMENT. Identification and organization of the cost data requirements to be included in the data collection instrument guided its design. The following criteria had to be met:

- compatibility with standard contractor cost accounting procedures
- readily transferrable to computer data bank
- reflects the true labor effort necessary to meet initial training development standards
- capability for the accommodation of future requirements.

The data collection instrument developed is presented in appendix E. It was modeled after a NAVTRAEQUIPCEN form used in contract negotiations for training device training courses. The format is based on the assumption that MIL-STD-1379 (A) will be used as the basic standard from which the Data Item Descriptions (DID's) are selected for all initial training course contracts. Parts I and II of the instrument address development effort and costs; Parts III and IV address the implementation effort and costs; Part V presents the G&A, Overhead, and Profit costs typical in all contractual efforts; and Part VI is a summation of the previous five parts and presents the total manpower effort and costs for the total initial training program.

PROCEDURE UTILITY. The information obtained using the data collection instrument will enable the development of a statistical baseline. This should prove a valuable tool for decision makers concerned with initial training cost efficiencies in the following ways:

- develop budgetary cost estimates
- evaluate contractor cost estimates
- compare contractor training development costs with Navy training development costs (see appendix C for Navy Cost Estimation Procedures).

The most efficient means of establishing this cost baseline is through the use of computers as storage and computational mediums. To illustrate this point, and to verify the utility of the proposed cost data collection instrument, a trial computer program was developed to provide information on labor effort and labor distribution. Although the sample of nine training device courses was not large, it does permit the demonstration of alternative ways that data can be manipulated and presented to meet the needs of the initial training manager. Modifications to both the instrument and the computer program can be made as experience is gained in their use. The computer program for the cost management control procedure was developed

using a WANG programmable calculator. The program itself is not included in this report; however, a sample copy of cost data output is provided in appendix F.

Cost data output, as presented in appendix F, can be put to several uses bearing in mind the following three constraints:

- Mean statistics (e.g., mean cost, mean hours, etc.) are most meaningful when expressed in terms of mean cost per instruction hour and/or mean labor hours per instruction hour. This fact was not discovered until late in the program. Therefore, summary figures in appendix F are expressed in terms of (unit) per instruction hour; the remaining figures are not. Since the data presented in appendix F are for illustration only, the remaining figures were not converted to (units) per instruction hour.

- All means were computed using an N of 9. This is satisfactory for each of the six contractual cost categories, except travel. That category appeared in only six of the sample cases. Although this difference in sample size causes a slight error in the resultant ratios and percentages, it does not detract from the basic procedure.

- For purposes of this investigation, appendix F data is presented in several different formats. Appendix F is not intended to represent a final data presentation format for the cost management control procedure, but rather to illustrate several methods for displaying the data. Further, not all data (e.g., research, liaison) required by the data collection instrument were separately identified. However, the total effort and cost of these omitted components is included in one of the other six categories. More detailed investigation may warrant the inclusion of such data at some future date.

Figure 1 provides one method of summarizing data found in appendix F. Based on figure 1, the mean cost of $324.86 per instruction hour could be used in preparing budgetary cost estimates for prospective training courses. Only the course length, in hours, is needed to complete such an estimate. In all likelihood, course length would be an estimate based on experience at this early phase of the acquisition cycle. Later, the data in figure 1 could be used during contractor cost proposal evaluations to determine whether the proposed costs are reasonably close to the mean cost and the cost distributions. Proposed costs and cost distributions not falling within acceptable limits for a specific cost category could be identified for more detailed analysis. In addition, this procedure could be refined to include additional factors such as the type of equipment for which the course is being developed, the technical complexity of that equipment, research effort required, method of instruction proposed (CAI, lecture, laboratory, etc.) and/or the type of acquisition (new equipment, modified equipment, etc.).

As previously stated, the labor cost category has the greatest impact on the total cost of the contract. Figure 2A is a breakdown of the total labor cost category depicted in figure 1. It depicts all labor classifications included in the labor cost category by mean time and percentage of the total time using the data from appendix F. The information displayed in figure 2A could be used for two purposes:

- to prepare budgetary estimates during the early planning phase of the acquisition cycle
- to compare, upon receipt of contractor(s) proposals, the proposed labor costs and labor distribution to identify areas outside of established tolerances.

Figures 2B and 2C depict labor distribution statistics for the development and implementation effort, the sum of which equals the total effort (figure 2A). Only seven labor classifications are shown in figures 2A, 2B, and 2C instead of the 10 developed for the data collection instrument. This is because the sample cost proposals selected did not include the three missing labor classifications; however, it is anticipated that these classifications would appear in a larger sample.

The important point regarding the statistics presented in figure 2 is that they are based on an N of 9 from a very restrictive type of procurement. If every labor classification appeared in every case, the statistics would give a more meaningful representation of labor distribution. Gross statistics; i.e., 13.3 labor hours per instruction hour for total labor effort, 1.7 labor hours per instruction hour for implementation effort, and 11.6 labor hours per instruction hour for development effort, are valid and usable in the evaluation of overall contract costs. The breakdown of these gross statistics by labor classification is not meaningful until verified.

Figure 3A depicts statistics based on the mean cost per instruction hour for each labor classification, again based on an N of 9 courses. The identical rationale relevant to the statistics of labor hours per instruction hour, as depicted by figure 2A, is applicable to the computation of the statistics presented in figure 3A. The mean cost of $133.43 per instruction hour for the total effort, $17.81 per instruction hour for the implementation effort, and $115.62 per instruction hour for the development effort are probably valid; the breakdown of these statistics by labor classification is not representative until verified by additional data.

Table 2 presents mean cost estimates by labor classification. These statistics were developed by taking the number of cases in which each labor classification appears and calculating the average hours per instruction hour and the cost per instruction hour. The difference between figures 2 and 3 and table 2 is that in the figures all nine cases were used in developing the mean; in table 2 only those cases wherein a specific classification appeared were considered. Because table 2 is based on actual case labor classifications, it is, for illustrative purposes, considered the standard for comparative

a. = Percent of Total Labor Effort

b. = Labor Hours Per Instruction Hour

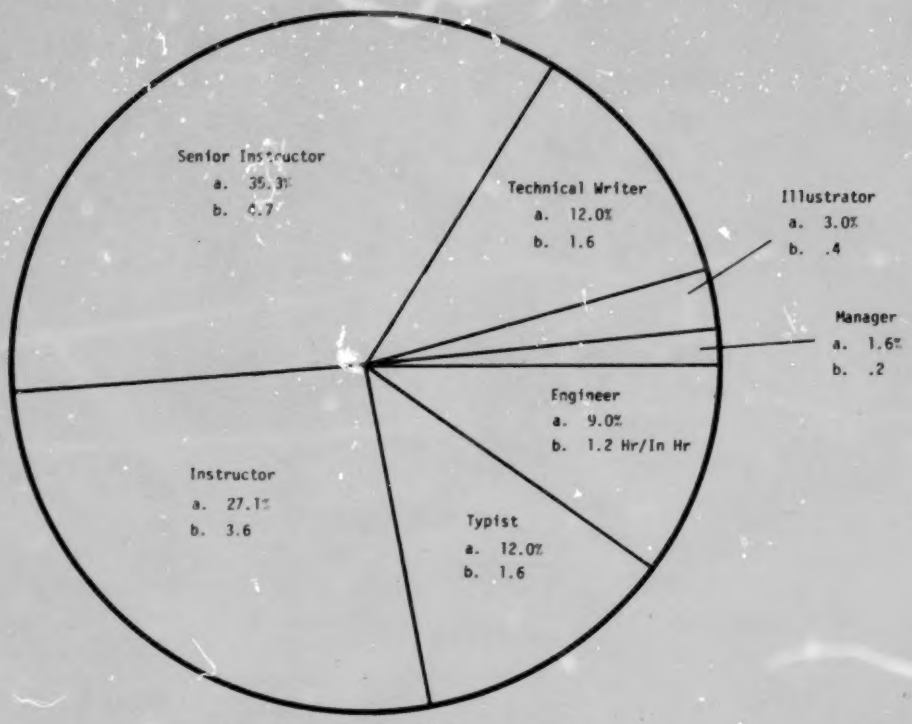

Figure 2A. Mean Total Labor (13.3 Hrs/Instruction Hr)

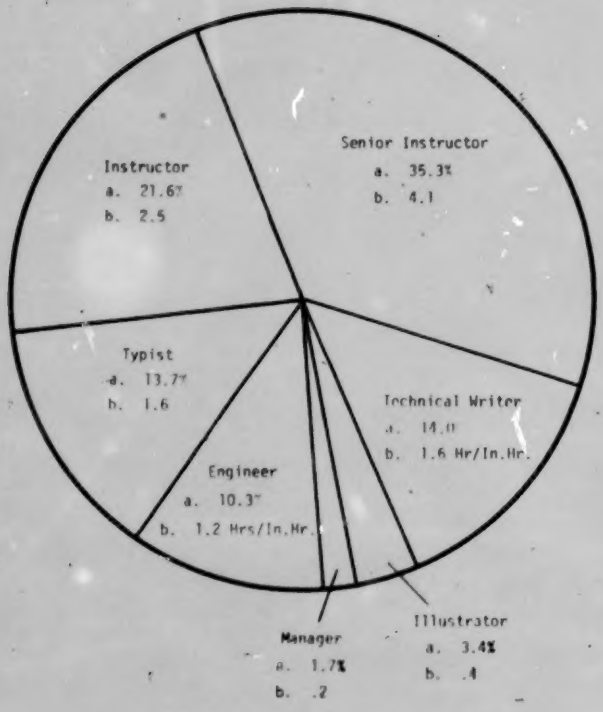

Figure 2B. Mean Development Labor (11.6 Hrs/Instruction Hr)

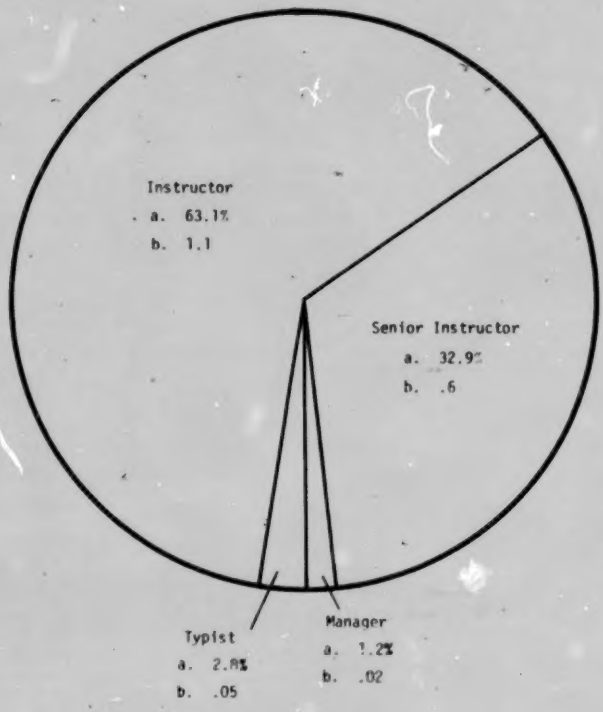

Figure 2C. Mean Implementation Labor (1.7 Hrs/Instruction Hr)

Figure 2. Summary of Initial Training Mean Labor Effort by Labor Classification

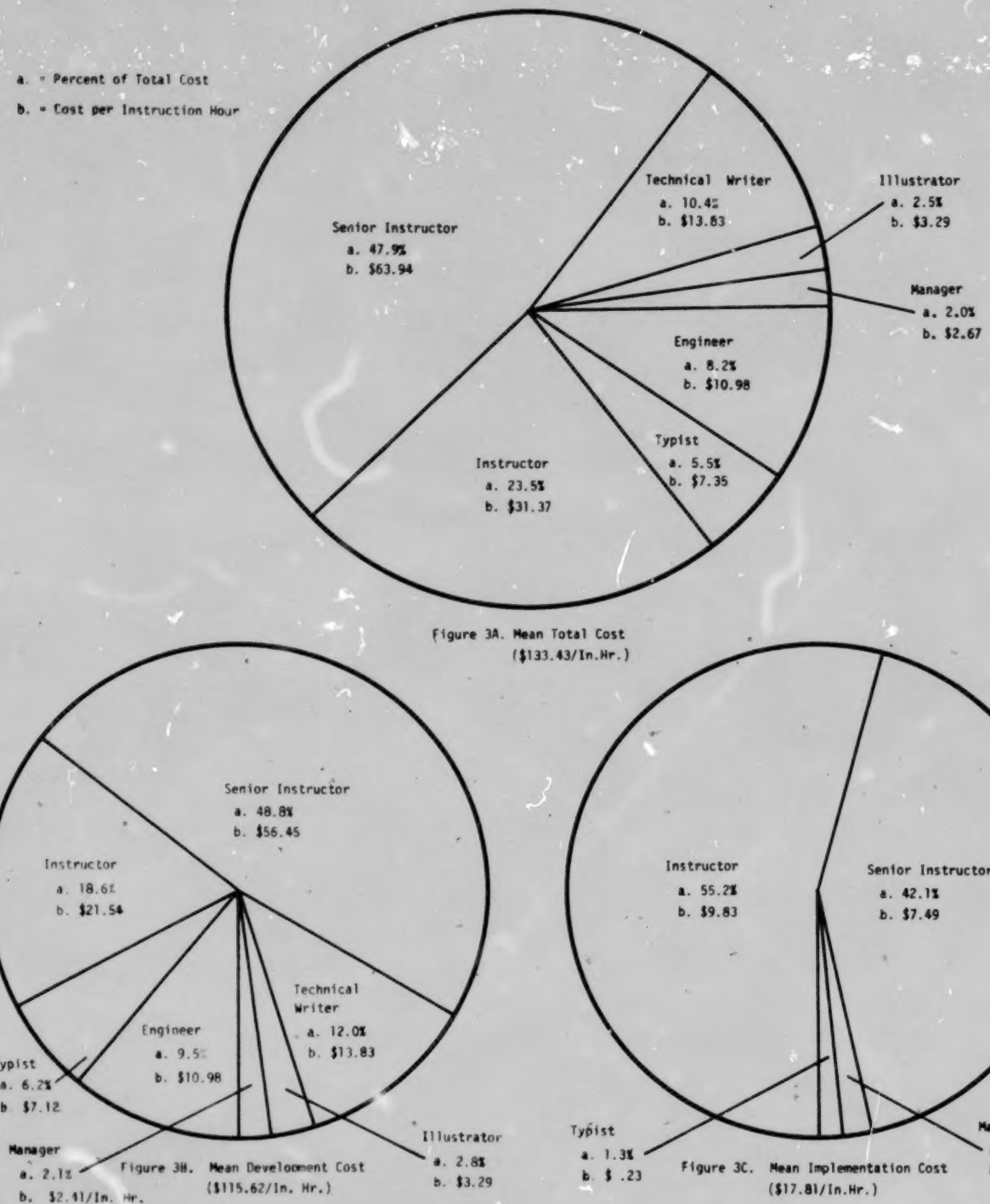

Figure 3. Summary of Initial Training Mean Labor Cost by Labor Classification

analysis. For example, the managerial function classification appeared in five of the nine cases considered. In figure 2, the hours per instruction hour were determined by summing the five cases (1.88 hours of total managerial hours per instruction hour) and dividing by nine. In table 2, the same sum was used, but the divisor was five, the number of cases in which managerial labor was identified.

TABLE 2. MEAN COST ESTIMATES BY LABOR CLASSIFICATION

Labor Classification	Labor Hours Per Instruction Hour	Cost Per Instruction Hour
1. Manager	.4	$ 4.80
2. Engineer	3.6	32.91
3. Typist	2.1	9.45
4. Instructor	5.4	47.06
5. Senior Instructor	8.5	115.09
6. Technical Writer	3.6	31.12
7. Illustrator	.7	5.91

PROCEDURE ILLUSTRATION. To illustrate the use of the procedure, a specific training course (Course "L" in appendix F) will be subjected to a comparative analysis. As a first step, the manager would develop a simple table depicting overall costs per instruction hour by contract cost categories and compare these to established mean costs (the costs identified in figure 1). This procedure is illustrated in table 3. Since no travel appeared in the contractor's cost proposal, the allocation for travel is not included in computing the mean total costs (line 1) or the percentage of mean costs devoted to each category (line 2). Table 3 reveals three categories where proposed course L costs exceed the anticipated (mean) costs by a significant percentage: labor, overhead, and profit. In addition, the material category is significantly less than expected. The labor category is the most costly and has the greatest effect on total contract cost. Moreover, since overhead, G&A, and profit categories are based on a percentage of the sum of the other three categories, any reduction in the labor category would reduce those costs proportionately. Reduction in labor costs would also raise the percentage of material costs relative to the total contract cost. Thus, further examination of the proposed labor costs should be undertaken.

TABLE 3. COMPARISON OF COURSE L CONTRACT TRAINING COSTS TO MEAN CONTRACT TRAINING COST BY CONTRACT COST CATEGORY

STATISTIC	CONTRACT COST CATEGORY ($/In. Hour)						
	LABOR	MATERIAL	TRAVEL	OVERHEAD	G&A	PROFIT	TOTAL
1. Mean (Figure 1)	133.43	14.49	NA	98.04	33.48	34.62	314.06
2. % of Total (Figure 1)	42.49%	4.61%	NA	31.22%	10.66%	11.02%	-
3. Course L	195.79	4.70	0	129.61	37.63	55.16	422.91
4. % of Total (Course L)	46.30%	1.11%	0	30.65%	8.90%	13.04%	-
5. Difference (3-1)	+62.26	-9.79	NA	+31.57	+4.15	+20.54	+108.85
6. % Difference (5 ÷ 1)	+46.70%	-67.56%	NA	+32.20%	+12.40%	+59.33%	+34.66%

One means of examining labor costs more closely consists of constructing a pie chart of the contractor's proposed labor distribution using hours of labor per instruction hour and a second pie chart based on the contractor's proposed cost per instruction hour by labor classification. The two charts developed are shown in figures 4A and 4B. Figure 4A indicates the total hours per instruction hour required to develop and present course L were 13.76, a difference of only 3.45 percent from the mean shown in figure 2A, an apparently acceptable difference. However, figure 4B shows that labor costs average $195.79 per instruction hour, a difference of 46.7 percent from the expected mean labor cost indicated in figure 3A. This difference is considered significant. From these facts, a manager might determine that either excessively priced labor classifications are proposed or that the cost of the labor classifications is significantly higher than anticipated. In the Course L illustration, a combination of both occur. The contractor proposed to use only senior instructors, no technical writers, engineers, or instructors. The contractor's senior instructor's cost of $174.94 per instruction hour is 52 percent over the mean cost for this labor classification (see table 2). If the manager procuring Course L had had this model available, he would have recognized the area which required additional negotiation.

PROCEDURE APPLICATION TO SYSTEM/EQUIPMENT ACQUISITION PROGRAMS. Some unsubstantiated cost data for major hardware system/equipment acquisition program initial training courses were obtained during this study. Major programs represented included the CGN-28 Combat System Maintenance Management Training (CSMMT) course, three proposed 1200 PSI training device courses, and the FFG-7 Central Control System Maintenance course. These data were converted to the proposed data collection instrument format, and pie charts were developed in accordance with the cost management concept for each course. The resultant statistics are presented in appendices G through K for information purposes.

FUTURE DEVELOPMENT EFFORTS

This section of the study has developed a cost management control procedure and demonstrated its application. More exact techniques for the estimation and evaluation of initial training costs are needed. Numerous areas exist which require additional investigation and analysis to complete the development and validation effort. Suggested areas for future investigation and/or development are presented in the following paragraphs.

1. Data Base. A primary, and obviously crucial, requirement is the development of a complete and substantive data base based on valid contractor initial training cost data. All data elements comprising this base should be collected in the standard format presented in appendix E.

2. Verification of Cost Categories and Category Classification. Cost categories identified in this report and the classification schema for the Labor Cost Category require verification. The possible need for additional cost categories has been indicated; because of its importance, the various types of labor classifications also need validation. In addition, consideration might also be given to separating types of travel costs (development and implementation) or developing other classifications for the various cost categories. As additional data becomes available, revisions/modifications should be inserted.

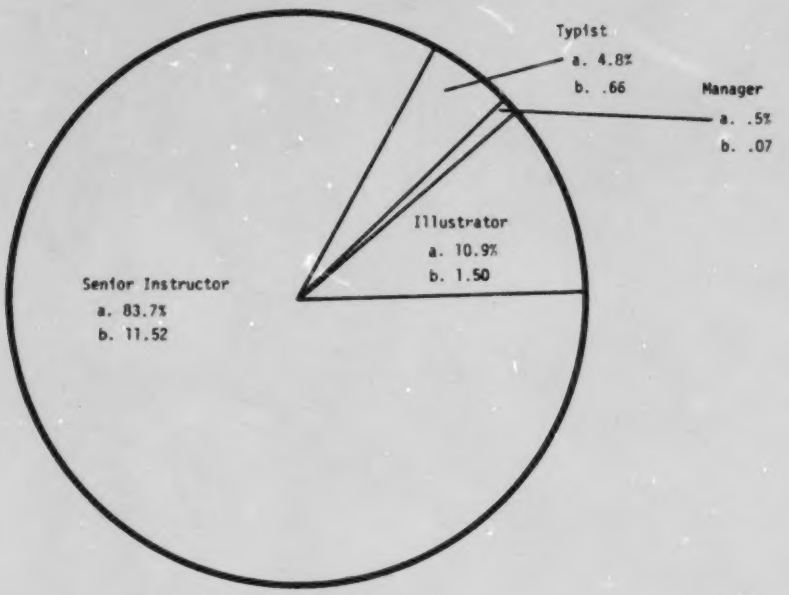

Figure 4A. Total Labor Effort Per Instruction Hour
(13.76 Hr/In.Hr.)

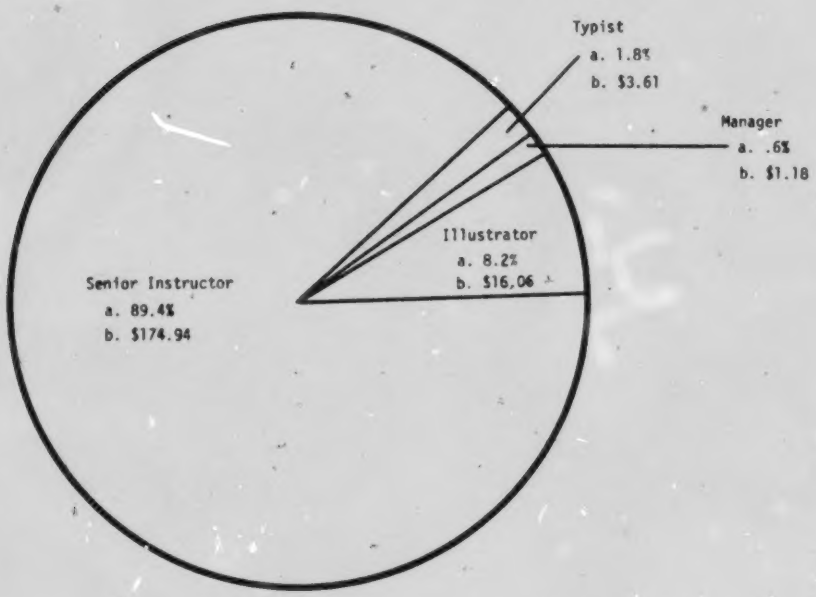

Figure 4B. Total Labor Cost Per Instruction Hour
($195.79/In.Hr.)

Figure 4. Course L Proposed Labor Effort and Labor Cost by Labor Classification

3. Course Location. The location of training courses (e.g., factory or onsite) may affect cost category statistics. Such impact, if any, should be determined. Category costs may also vary dependent on the amount of travel required.

4. Training Course Classification. Technological advances may cause technical complexities in course development efforts, special user requirements, etc. These and similar variables may affect costs of developing and implementing initial training. In these cases there may be required the determination of training course classifications by technical complexity; however, the number should be held to a minimum.

5. Instruction Techniques. The influence of types of instruction (e.g., classroom, laboratory, class/laboratory mix, CAI, etc.) on cost per instruction hour should be examined.

6. Statistics. The basic statistic used in the appendix F data was the mean. Consideration should be given to the use of other statistics, such as the median, to form the baseline for cost estimations and evaluations. A procedure for establishing confidence intervals for cost statistics should be developed.

7. Course Length. Course length is a variable that influences the statistics for cost per instruction hour and labor effort per instruction hour. Groupings by course length may demonstrate a need for statistical baselines for each interval. As an example, intervals of 0-160 hours, 160-320 hours, and 320-480 hours were arbitrarily established from available data, and averages of cost per instruction hour and development hours per instruction hour data were derived and plotted against course length (at the midpoint). The resulting plots, shown in figure 5, suggest that both cost per instruction hour and development labor effort per instruction hour decrease as course length increases. Considering the quality and quantity of the data from which the plots were derived, this study in no way implies that the negative slopes shown in figure 5 are representative of what actually may exist. However, future investigations should consider the relationship between course length and cost and labor effort.

8. Data Output Display. Future investigations should address the format and information content of the final data output. The final output data should consist only of required information and be readily interpretable by the user.

SUMMARY

The cost management control procedure presented in this section is intended as a decision aid for the acquisition manager of initial training programs. As such, it provides factual information which can assist him in the selection of the most appropriate and cost effective initial training alternative for a given acquisition. Decisions should not be based on assumptions when factual information is available to aid in the decision making. Clearly, the use of this procedure is preferable to decisions based on assumptions and/or unsupported judgment. On the other hand, costs alone should not be the only criterion upon which an initial training decision is based.

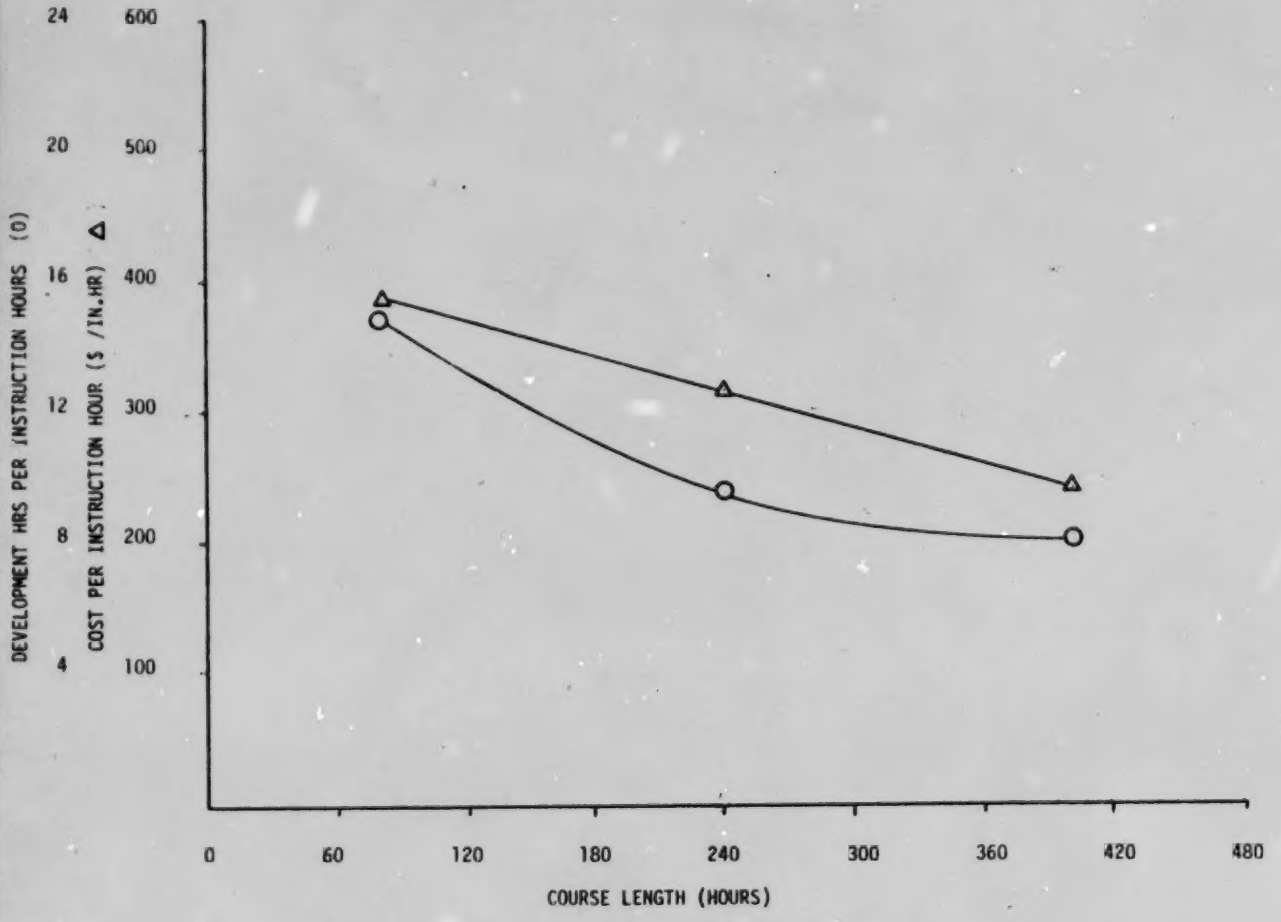

Figure 5. Labor Effort and Labor Cost Versus Course Length

If development of the proposed procedure is pursued rigorously, the eventual product will be a tabulation of relevant cost statistics that can be updated regularly to accommodate changes in the data base. Given variables such as course length, location, types of training, and course complexity, managers can locate the appropriate statistic(s), determine probable costs for such a course, and evaluate submissions based on deviations from realistic estimate of anticipated course costs. Proposed contractor costs and effort for each of the major cost categories, perhaps broken down into classifications within categories, could be verified through comparison with mean statistics. Thus, the reasonableness of contractor proposed costs for particular courses under consideration can be established. The intent and purpose of the cost estimation/evaluation procedure presented here is well summarized in the following quotation:

> By formalizing the procedures of analysis and making explicit each facet of the analysis, managers will have a powerful tool to aid in decision making. Economic analysis was not intended to, nor could it, make the decision. There simply are too many qualitative factors involved in most decisions to enable the analysts to select a set of quantitative criteria which can be used alone as the basis for making totally objective decisions. Judgment and evaluation have always been required in management and decision making and will continue to play a significant role. When the amount of judgment required can be reduced by explicit economic analysis then decisions should be measurably improved (Swope, 1976, p. 43).

SECTION III

NONCOST FACTORS INFLUENCING SELECTION AMONG INITIAL TRAINING ALTERNATIVES

Assuming its availability and completeness, an analysis of cost data is an essential and critical part of any initial training decision process. The preceding section of this report presents a cost management control procedure that is designed to provide such cost data. However, it is insufficient to use quantitative information, such as cost, by itself in selecting among initial training alternatives for program development and implementation. This section identifies and describes, in general terms, major noncost factors that are relevant to a comprehensive review of all available data affecting the selection process.

Noncost factors are essentially qualitative in nature. As such, they are:

- not normally described by objective data and, therefore, are not easily assigned values for objective analysis
- extremely interactive in that they affect, and are affected by, each other and quantitative factors such as cost
- broadly influential; a decision based on any single factor may have effects that extend beyond the general area where the effect was anticipated
- long term in their effects.

Identification of these factors resulted from case history analysis. For purposes of this presentation, they have been separated into two arbitrary groupings: first, factors that specifically relate to the cost management control procedure developed in the previous section; and, second, factors that require more general consideration. This is considered to be an initial list which is by no means comprehensive or exhaustive. Additional factors may be identified as experience is gained. Moreover, because of insufficient documentation on which to base specific conclusions, estimates of the relative importance of these factors can not be derived. Although their effects are generally understood, significant effort is required to define both the factors and their effects more accurately.

QUALITATIVE FACTORS RELEVANT TO THE COST MANAGEMENT CONTROL PROCEDURE

The factors presented in this grouping tend to be specific in terms of their influence on the cost management control procedure. They influence cost estimation and evaluation and/or will serve as the basis against which specific trade off decisions can be made. They include, but are not limited to, the following:

1. Course Type. Guidance on the selection among initial training alternatives can be taken from the course itself. For example, technical courses; i.e., theoretical courses leading to technical competency and management oriented courses have many similarities, but imply different needs for course development and implementation. In contrast maintenance and operation courses, both of which require training devices or operational equipment, suggest a different orientation. The difference in cost to develop and implement each of these types of courses will vary and may, eventually, be identified. A consideration of the orientation of the course will become a necessity as the training manager decides who should develop the course needed.

2. Course Complexity. The type of hardware under development dictates course complexity and may require the selection of particular kinds of development and implementation personnel, a special physical plant, or other factors to be considered during the decision making process. For example, if new equipment reflecting some recent technological innovation were introduced into the Navy, it is doubtful that Navy personnel would possess the knowledge needed to develop and present initial training courses for that equipment. Under such circumstances, contractor development would probably be selected.

3. Course Length. Course length obviously affects course costs. It also acts in a qualitative way to affect the initial training alternative selection decision. Course length has implications for personnel manning. In addition to their competency and/or capability, the acquisition manager must consider personnel stability in terms of the development/implementation of the course. If course length is to be such that military personnel stability cannot be maintained during the development of an initial training package, it may be necessary to use contractor resources even though costs may be higher.

4. Target Student Population. The characteristics of the student population will influence the selection decision for initial training development and implementation by Navy or contractor personnel. For example, initial training courses for officers may be different than similar courses for enlisted personnel. Within the enlisted ranks, the level of expertise required or anticipated will be different among courses targeted for schools with different technical levels of capability.

5. Process Factors. The differences in process that exist between the Navy and contractor development of initial training programs may influence the selection decision. Within a normal procurement cycle, contractors are subject to a variety of requirements during Procurement Planning (identification of requirements to Request for Proposal (RFP)), Solicitation (RFP through contract award), and Post Contract Award (contract award to delivery of course) phases that Navy developers may not be required to meet. Therefore, Navy personnel may be able to complete the process in less time. The effect of such differences in process may be reflected in terms of time to accomplish, urgency of requirement, and/or cost.

In addition, the award of a contract to a vendor requires different management controls than might be found if similar work were assigned to a Navy organization. The kind of coordination required for a specific course may be more effectively accomplished under one set of controls, influencing the selection of one developer over another.

Process factors may eventually be translated into dollar amounts for inclusion in objective cost analysis using the proposed cost management control procedure. However, until more data become available, the influence of these factors will remain essentially a matter of personal judgment and subject to trade-off analysis.

6. Facility Factors. The availability of facilities in which to develop and/or implement initial training courses may influence the selection decision. Space may be available to the Navy on a no-cost basis for internal course development, as was the case when the Navy developed the CSMMT course for the CGN-38. Requirements for implementation may include the need for large amounts of space, as illustrated by the DD-963 initial training course for engineers. The cost of required space, and its availability, will bear on the decision of where to present the course. Other facility factors which must be considered during a trade-off analysis are proximity to the work force and, possibly, terrain characteristics.

7. Security. Certain courses require stringent security measures. The ability of a contractor to insure such measures involves consideration of the availability of personnel who can meet clearance requirements in addition to physical plant and document security. Under certain conditions, it is conceivable that this variable might become a determining factor in a selection decision.

GENERAL QUALITATIVE FACTORS

The three qualitative factors which follow are generally applicable to all aspects of the initial training process. Although they are important considerations in the selection of one initial training development/implementation alternative over another, they may also interact in decisions related to funding and/or logistic support.

1. Change. Selection of an agent for initial training development/implementation should not be made without some consideration of his ability to accommodate change. Consideration of the capability of the contractor or the Navy to modify training to accommodate changes in minimum time at least cost must be considered by the acquisition manager in the selection of the training agent.

The following are illustrative of the types of changes that might occur:

- Technological Change. Rapid advances in technology may dictate modification requirements for a system/equipment under acquisition. These changes imply a concurrent change in instructional programs being developed to support it. In making a selection decision, training managers should consider which agent can best accommodate such change. Included as elements in this consideration are the technical abilities of personnel, the capability to provide retraining, if required, and instructional flexibility.

- Funding Change. Three potential types of funding change must be considered by the acquisition/training manager. The first of these involves cost changes (material, labor, etc.) which are normally considered as a part of an objective cost analysis/estimation procedure. Secondly, acquisition/training managers must be prepared to accommodate changes in funding source (e.g., from RDT&E accounts to procurement accounts), with attendant changes in requirements. Lastly, changes in the more general levels of defense budgeting occur based on Congressional actions. Each of these three types of funding change impact acquisition programs. Since training considerations are generally subservient to hardware considerations, any initial shifting of funding is done to insure the least effect on the actual hardware, creating a negative influence on training funding. Thus, acquisition managers must consider what kind of training developer, contractor or Navy, could best accommodate such actions should they occur.

- Changes in Instructional Technology. As in the growth of technology for system/equipments, technical advances in state-of-the-art techniques and methods of instruction occur. Such advances may affect courses being developed/implemented and have implications for the coordination between initial training and follow-on training activities. Specifically, response to a change in instructional technology implies three considerations: cost, time, and capability to incorporate the change in the course. Acquisition managers, in the selection of a training agent, must give weight to these factors, particularly for long-range programs.

2. Attitudinal Factors. The attitude; i.e., general atmosphere, which surrounds the initial training process affects the actions and behaviors of the working level personnel. The approach decision makers take to solving problems is strongly affected by their attitude toward the program. These two attitudes interact, and decision makers must be concerned with these attitudes when making the initial training development selection. Two problem areas are of particular concern in making the initial training selection decision:

- The Low Priority of Training. Despite policy provisions to the contrary, personnel preparation through training has assumed a role secondary to that of material acquisition. The impact of this condition is seen in reduction of training and training-related funds during times of monetary constraint, failure to make a timely assignment of adequate numbers and types of training personnel, and scheduling slippages because of inadequate attention being paid to training needs. The training agent selection decision should consider the capabilities of the Navy and the contractor to respond to these types of problems should they occur.

- Competition Among Affected Commands. An increasing tendency to become concerned only with those factors that are of immediate concern to a specific agency has led to a competitive attitude between commands responsible for initial training and those responsible for follow-on training. This is further aggravated by resource limitations. This can result in program disruption, inadequate documentation and/or training support, and insufficient coordination/communication during the development process. Awareness of these potential problem areas is essential in making training program decisions.

3. Management Factors. During the data gathering phase of this study, it became apparent that factual information related to resource expenditures and equipment history was not readily available. Cost data was scattered among various activities and was not maintained in a consistent and usable form. Historical data was, generally, available only from persons who had been involved with the decision making process. Acquisition managers frequently relied upon individual notes or memory rather than formal documentation, and problems were evidently solved more by intuition or along traditional lines rather than on the basis of factual knowledge. The following specific qualitative factors should be considered by acquisition managers as they affect both the hardware and the training portions of all programs:

- Cost Data Records. Cost data should be divided by category with each covering a major element of the acquisition program. Individual cost items, regardless of the source of funds, should be recorded within their element and one central file of all costs maintained readily available to the decision makers. Thus, the record of all training costs would be maintained as a subelement under Integrated Logistics Support (ILS), regardless of who ordered and who funded the training.

- Historical Data Records. The need to trace the source and reason for a given decision frequently arises. Such information can have a profound impact on future decisions, particularly when the original decision makers and/or their rationale are not available. Project managers should consider the establishment of a central file of historical data, to include the rationale behind specific decisions, similar to the one proposed for cost data.

SUMMARY

In addition to the cost factors addressed in the previous section, non-cost, or qualitative factors, which must be considered by decision makers were identified. These were divided into two major categories; i.e., qualitative factors relevant to the cost management control procedure and general qualitative factors.

The first, factors affecting cost management, are specific in terms of their influence on program costs. Seven individual areas were identified.

The second, general factors, were nonspecific in nature and tended to have influence on all aspects of the acquisition program as well as the training process. Three major areas were identified as deserving of the acquisition manager's attention.

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

This section contains conclusions concerning current policy, practices, and procedures affecting initial training in major surface system/equipment acquisitions and recommendations for improving the overall efficiency of initial training management. These conclusions and recommendations are derived from two sources of information: (1) data contained primarily in the body of the report, which is specifically applicable to the development of the proposed cost management control procedure and (2) that information and supporting data contained primarily in the appendices and which is applicable to initial training in the more general sense. This distinction is reflected in the organization of this section. Areas which require additional investigation are identified when appropriate.

CONCLUSIONS AND RECOMMENDATIONS: COST MANAGEMENT CONTROL PROCEDURE

1. Satisfactory training has resulted from the use of each initial training alternative; i.e., Navy prepared and presented, contractor prepared and presented, or some mix thereof. However, available evidence was not sufficient to prove or disprove the training effectiveness or economic advantage of one alternative over another for a given situation.

2. The efficiency and effectiveness of initial training programs are frequently functions of the personal experience of the individuals managing the programs. This is primarily due to the fact that a central repository does not exist which processes, stores, and disseminates historical management and cost data for initial training programs. These data would be valuable to acquisition managers in selecting among initial training alternatives and in the day-to-day management of initial training programs.

Recommendation: A central repository should be established for the collection, storage, and dissemination of all initial training historical management and cost data. General purpose, commercially available computer systems should be used for the processing and storage of data. Standard formats should be developed for input and output data and made readily accessible by acquisition managers for use in the decision making process.

3. A precise standard method is needed for developing initial training budgetary cost estimates and for evaluating contractor initial training cost estimates.

Recommendation: Further development of the cost management control procedure illustrated in section II of this report is recommended. Particular emphasis should be given to the labor cost category area which includes labor distribution, classification, and utilization relationships. A statistically valid sample of actual negotiated contractor initial training cost data should be collected.

a. Utilization of the data collection instrument presented in appendix E is recommended for all initial training procurement solicitations. This instrument includes all MIL-STD-1379(A) requirements but requires validation and revision as necessary.

b. The sample cost data summary presented in appendix F should be evaluated using actual contract cost data and revised as necessary. The use of actual contract cost information will provide data that can be used by acquisition managers in the preparation of budgetary estimates and in contractor proposal evaluations.

4. Contractor initial training technical and cost proposal submissions are normally evaluated by the acquisition manager. Training community personnel, familiar with instructional procedures and the development effort required for various types of initial and follow-on training requirements, do not normally participate in this function.

Recommendation: Formal procedures should be developed and implemented to increase participation by and utilization of training command personnel in all major elements of the initial training process. Training community participation would permit utilization of existing training expertise, allow for coordination of delivery schedules, reduce delays in the overall evaluation cycle, and prevent future misunderstanding regarding training package requirements. A precise definition of responsibilities and assignments early in the program would mitigate these management problems.

CONCLUSIONS AND RECOMMENDATIONS: GENERAL INITIAL TRAINING

5. The provision of initial training for complex and diverse types of systems/equipment is a sophisticated, highly variable process not conducive to comprehensive examination on a short term and/or limited data basis.

6. The relationship of initial training to manpower allocation and assignment, hardware acquisition, funding procedures, and similar areas involves numerous commands. These commands may have interests that are not always compatible. Since initial training and manpower actions originate with the acquisition command, a study concerned with these broad relationships is most appropriately performed by the acquisition command, with inputs solicited from all affected commands and activities.

Recommendation: Information and procedures contained in this study should be used as the basis for follow-on investigations into the initial training process and its relationships with areas such as manpower allocation, hardware acquisition, and funding. These future investigations should be coordinated at the OPNAV level and conducted by appropriate hardware acquisition command(s) with input from affected commands and activities (e.g., CNET, NAVPERS, etc.). It is further recommended that future investigations use data acquired through the actual tracking of a representative sample of new acquisition programs from the time of OR approval through CNET acceptance of the initial training course.

7. Training and training related functions are, by and large, viewed as being of secondary importance to actual hardware in the acquisition process. Consequently, resources are often allocated to accommodate other (usually hardware) goals with insufficient attention to the effects of these actions upon future hardware training requirements.

8. Existing directives are explicit in their definition of initial training policy and procedures. However, in some instances this explicitness places unnecessary constraints on program managers. Broad policy directives would permit program managers greater flexibility in dealing with every day management problems.

Recommendation: Existing initial training policy directives should be reexamined and revised to eliminate program management constraints which impair management flexibility.

9. Coordination of initial training requirements between the Training Support Agent (TSA) and the Training Agent (TA) (which should begin early in the planning phase and continue through acceptance of the training package) is a critical factor. This coordination frequently does not commence until late in the development phase. Complications arising from this practice include scheduling delays, ineffective training packages, costly redevelopment effort, inefficient use of available resources and management problems.

10. Long term cost avoidance may be realized if initial training resource allocation (funds and personnel) is made larger earlier in the acquisition cycle. The increase in program efficiencies and the quality of completed initial training programs may offset losses from fund expenditures on programs that are cancelled at some point in the cycle.

Recommendation: An investigation should be initiated to determine the benefits which might be derived by an allocation of resources for initial training prior to Milestone II (Full Scale Engineering Development), so as to involve affected commands/activities earlier in the acquisition cycle. The study would determine whether or not the annual costs for initial (planning) work on programs not implemented (effectively, a loss) would be different from the annual savings that might occur for programs implemented that can be attributed to the early coordination efforts by affected commands/activities (effectively, a cost avoidance).

11. The Ship Acquisition Program Manager (SHAPM) for a ship acquisition program usually assumes total responsibility for PRECOM training, including initial training, regardless of who developed the individual equipment or system. Equipment/system acquisition managers often address the equipment/system training for which they are responsible independently from the PRECOM training package. These practices can result in inefficient program integration and a duplication of training with consequent cost escalation.

12. Every initial training requirement should be examined on an individual basis with both quantitative and qualitative factors taken into account in determining who should develop and present the course. Traditionally, acquisitions that involve a high percentage of advanced technological effort have required contractor developed initial training; acquisitions based primarily on existing technology and/or lower percentages of advanced technology may use Navy or a Navy/contractor mix for initial training development. However, these general guidelines may not hold true in all cases.

13. Some acquisitions use Training Review Teams (TRT), composed of representatives from involved commands, to perform periodic initial training course development reviews. These teams can be an effective management control agent, enhancing coordination among commands in terms of course requirements, program schedules, data packages, and resource distribution.

Recommendation: The use of Training Review Teams may be appropriate in a variety of situations, including both large and small acquisition programs. However, under some conditions, the use of these teams may not be economically defensible in terms of funding or manpower requirements. Investigation of the appropriate conditions wherein the use of TRTs is economically feasible is warranted.

14. In major acquisitions, the intangible benefits of experience, continuity, program familiarity, and morale may be lost because of the sea/shore rotation policy affecting Naval personnel. The value of such intangibles should be considered when selecting military personnel to participate in the development of initial training.

Recommendation: The Training Command should develop and maintain a core of specialists, both military and civilian, whose technical expertise has been developed through participation in the training elements of major acquisition programs. Specifically, a career path for Naval personnel should be developed that would provide shore duty (within the training command) emphasizing acquisition program/initial training expertise, interspersed with operational assignments within warfare/career fields.

15. All initial training courses should be procured in accordance with the requirements of the one contractually acceptable standard by all acquisition commands. Internal command directives may not necessarily be contractually acceptable and may cause program delays and cost increases.

Recommendation: MIL-STD 1379(A) is recommended as the single standard upon which all initial training programs are developed.

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APPENDIX A

DEFINITIONS AND ACRONYMS

DEFINITIONS AND ACRONYMS

AB	Allocated Baseline
AT	Acceptance Trials
Balance Crew Training	Training given to nonnucleus crew personnel assigned to fill-out assigned complement/allowance of initial ships/ acquisitions/equipments. Conducted at a training center (which may be onsite or separately located); emphasis is on group/team training, with individual training provided en route if required at a schoolhouse.
CIWS	Close In Weapon Support
COMBATSYSTRAGRU	Combat System Training Group
CNET	Chief of Naval Education and Training
CNTECHTRA	Chief of Naval Technical Training
DSARC	Defense System Acquisition Review Council
FB	Functional Baseline
Follow-on Training	Any training conducted subsequent to initial training
ILS	Integrated Logistic Support
Initial Training	Training provided for the first ship, system or equipment of a series. Also, that training, usually provided by the TSA, performed pending the opportunity for the TA to acquire the capacity for such training.
LBTS	Land Based Test Site
MCON	Military Construction
NTEC	Naval Training Equipment Center
NTP	Navy Training Plan
NTPC	Navy Training Plan Conference
NTU	Navy Training Unit
Nucleus Crew Training	The training of the 1st (and 2nd, if required) increments of officers and men who are especially selected specialists and who will initially man designated systems aboard/ related to new acquisitions/equipments. Usually performed onsite. Usually emphasizes individual (vice team) training, in both operations and maintenance areas.

OR	Operational Requirement
PB	Product Baseline
POA&M	Plan of Action and Milestones
PRECOM	Precommissioning
Precommissioning Training	The process of assembling, organizing, and training the officers and men comprising the crews of ships (and other water-borne craft) being placed in commission or in service. Training as needed, or required/ordered by the PCO. Included are: (1) preparation of commissioning, (2) dockside trials, (3) fast cruise, (4) underway trials, (5) ready-for-sea training, (6) qualifications and special tests, and (7) shakedown training. Individual, group and team, schoolhouse, onsite, watch and GMT training are included.
SHAPM	Ship Acquisition Program Manager
SWOS	Surface Warfare Officers School
TA	Training Agency
Training Agency	Any office, bureau, command, or headquarters exercising command of and providing support to some major increment of the Department of the Navy formalized training effort. Responsible for training, including factory training on equipment no longer in production, or where Initial Training (related to factory training) has been completed. Supervises and regulates training programs for military personnel. Furnishes training requirements to TSA for timely insertion in programming and budgeting system.
TAEG	Training Analysis and Evaluation Group
TSA	Training Support Agency
Training Support Agency	An office, bureau, command, or headquarters responsible for supporting the Training Agency's (TA) by providing material and other forms of support within the cognizance of the office, bureau, or command involved. Responsible for factory training of civilian personnel and the initial training of personnel assigned to new acquisitions, equipments, or systems.

APPENDIX B

LIST OF COMMANDS AND ACTIVITIES CONTACTED

LIST OF COMMANDS AND ACTIVITIES CONTACTED

Chief of Naval Operations (OP-39, OP-099), Washington, DC

Commander Naval Sea Systems Command (Sea 0243, Sea 047, Sea 653, Sea 654, PMS 301, PMS 306, PMS 377, PMS 378, PMS 399, PMS 404), Washington, DC

Chief of Naval Education and Training (N-31, N-5), Pensacola, FL

Chief of Naval Education and Training Support (N-4), Pensacola, FL

Chief of Naval Technical Training (N-32, N-33, N-35, N-43), Millington, TN

Service School Command, Great Lakes, IL

Surface Warfare Officers School, Naval Education and Training Command, Newport, RI

Land Based Test Site, Sperry System Test Center, Long Island, NY

Naval Training Equipment Center, Orlando, FL

Combat Systems Training Group, Millington, TN

APPENDIX C

AN ILLUSTRATION OF A COST ESTIMATION PROCEDURE FOR NAVY DEVELOPED INITIAL TRAINING

AN ILLUSTRATION OF A COST ESTIMATION PROCEDURE FOR NAVY DEVELOPED INITIAL TRAINING

This appendix presents selected discussions from TAEG Technical Memorandum 77-5, Precommissioning Training, to illustrate the procedures used to estimate the cost of the Navy developed and implemented Combat System Maintenance Management Training (CSMMT) for the CGN-39 (USS TEXAS). It is concerned only with procedures for estimating Navy developed initial training costs; therefore, the procedures presented in TAEG Technical Memorandum 77-5 for estimating contractor initial training costs are not included here. The cost estimation procedures illustrated in this appendix can be adapted for any Navy developed initial training program, and, when used in conjunction with the contractor cost estimation concept presented in the main body of the report, provide a viable method for cost comparison of the two alternatives.

BACKGROUND

The CSMMT course for the CGN-38, the first ship of its class, was developed and conducted by Control Data Corporation (CDC) under Contract N-00024-74C-0230 with the Ship Acquisition Program Manager (SHAPM) (PMS-378). Follow-on training for the CGN-39 and remaining ships in the CGN-38 class would normally have been provided by appropriate Navy activities; however, the following combination of CGN-38 related events prevented this normal follow-on training cycle for the CGN-39 from taking place.

1. The contractor conducted CSMMT course for the CGN-38 was not satisfactory, primarily due to inadequate documentation, and was not acceptable to the Chief of Naval Technical Training (CNTECHTRA).

2. The Combat System Maintenance Training Facility (CSMTF), Mare Island, was not complete and did not have the capability to provide CSMMT for the CGN-39.

3. The contractor's estimate of $200,000 (reference Chief of Naval Air Technical Training ltr Code 7012/RWS:mbm of 27 December 1976) to develop and conduct a CSMMT course for the CGN-39 was considered excessive.

These events led to the SHAPM and Chief of Naval Operations (CNO) decision to task and fund the Combat Systems Training Group (COMBATSYSTRAGRU) to develop and conduct a CSMMT course for the CGN-39. This Group was composed of highly experienced personnel uniquely qualified for the task. The CSMMT course and a modified version of this course were successfully presented to a total of 70 students during the periods October through December 1976 and January - February 1977. They were given in Navy controlled facilities at Newport News, Virginia.

METHODOLOGY

Data necessary to develop an estimate of the Navy's costs for the development and implementation of the CGN-39 CSMMT course were obtained from the COMBATSYSTRAGRU personnel, Bureau of Naval Personnel Billet Cost Model (1975), and the General

Services Salary Schedule (1975). The concepts and procedures of economic analysis set forth in TAEG Report No. 31, A Primer on Economic Analysis for Naval Training Systems, (Swope, 1976), were followed in developing the cost estimate for the CSMMT program. No attempt was made to identify and compare the real benefits of the training courses, such as improved job performance through reduction in accident rates, downtime, equipment failure, etc. Such detailed analysis was beyond the scope of this effort; however, such factors should be included as an integral part of future cost estimates for Navy developed initial training programs.

NAVY DEVELOPED CGN-39 CSMMT COST ANALYSIS

The development and implementation costs for the Navy developed CGN-39 CSMMT were determined in a somewhat different manner than the costs for contractor developed CSMMT. This procedural change was necessary to accommodate the type of data available for analysis; however, the procedural difference does not detract from the validity of the Navy cost estimate or the comparability of these training costs with contractor developed initial training costs. The formula (development and implementation) upon which this cost analysis is based is:

$$\text{TOTAL COST} = F + E + IMD + P + S + ST + M$$

WHERE F = FACILITY COST
E = EQUIPMENT COST
IMD = INSTRUCTIONAL MATERIAL DEVELOPMENT COST
P = PERSONNEL COST
S = SUPPLY COST
ST = STUDENT COST
M = MISCELLANEOUS COST

1. Specific Assumptions:

a. The development facility had no real worth as it had exceeded its life expectancy and was scheduled for razing.

b. Development equipment had no real worth as it had exceeded its life expectancy.

c. A man-year consists of 2,080 hours for purposes of converting yearly salaries to hourly rates.

d. Twenty-five percent of the CGN-38 CSMMT course was usable in the Navy developed CGN-39 CSMMT course.

e. Personnel costs for Naval personnel are burdened; civilian Naval personnel costs are not burdened.

2. Given: (Based on COMBATSYSTRAGRU Data and Assumptions)

DATA ITEM	DEVELOPMENT	IMPLEMENTATION
1. Average Professional Rate	$12.649/HR	$12.722/HR
2. Average Clerical Rate	$ 4.343/HR	$ 4.343/HR
3. Total Professional Hours	5,025 HRS	2,426 HRS
4. Total Clerical Hours	347 HRS	0
5. Total Facility Area	11,088 FT^2	NA
6. COMBATSYSTRAGRU Facility Area	750 FT^2	NA
7. Facility Maintenance Cost/yr.	$ 8,175/YR	NA
8. Facility Utility Cost/yr.	$ 9,500/YR	NA
9. Supplies	$ 644	$1,258
10. Support Cost	$ 6,083	$8,210
11. CGN-38 CSMMT Development Cost	$191,827	NA

3. Development Cost Computations:

a. F = MAINTENANCE + UTILITY COSTS

$$F = (\$8,175 + \$9,500)\left(\frac{7 \text{ Mos}}{12 \text{ Mos}}\right)\left(\frac{750 \text{ FT}^2}{11,088 \text{ FT}^2}\right)$$

$$F = (\$17,675)\ (.583)\ (.068)$$

$$F = \$701$$

b. E = 0

c. IMD = $6,083

d. P = TOTAL HOURS X AVERAGE LABOR RATE

(1) PROFESSIONAL = 5,025 HRS X $12.649/HR = $63,561

(2) CLERICAL = 347 HRS X $ 4.343/HR = 1,507

P = $65,068

e. S = $644

f. ST = 0

g. M = 0 (No actual expenditures could be identified for this category.)

This cost analysis is based on the identification of the total actual costs incurred or avoided by the Navy in the development of the CGN-39 CSMMT course. However, it is apparent from the study investigation that the contractor's CGN-38 CSMMT course material and development effort provided a significant contribution to the COMBATSYSTRAGRU's timely and successful development of the CGN-39 CSMMT course. The COMBATSYSTRAGRU estimated that 25 percent of the CGN-38 CSMMT course material was used, and thus this amount of development effort was avoided in the development of the CGN-39 CSMMT course. This means that in terms of time and monetary savings, the CGN-38 CSMMT program was of value to the COMBATSYSTRAGRU, and this value must be considered in decisions regarding the cost.

Technically, a monetary figure representing the value of the CGN-38 CSMMT program should not be included in a cost analysis concerned with the total actual costs incurred in the development of a training course. However, the Navy developed CGN-39 CSMMT course represents a unique situation with broad implications for future initial training programs. The study investigation suggests the importance of recognizing all cost considerations to include the avoidance of cost value of the CGN-38 CSMMT course to the CGN-39 CSMMT course development effort. Failure to include this value (i.e., monetary avoidance to the CGN-39 CSMMT course development effort) of the CGN-38 CSMMT program in the total cost computation of the CGN-39 CSMMT course development effort would create a misleading baseline for future initial training program decisions. The impact, in terms of estimated value, of the CGN-38 program was significantly relevant to the total cost to the Navy. For this reason, a deviation from standard cost analysis techniques is justified and the estimated cost avoidance value of the CGN-38 CSMMT program is included in the total cost of the Navy developed CGN-39 CSMMT course. The actual total Navy expenditure for the CGN-39 CSMMT course is determined by subtracting the Navy avoidance of costs of development of the CGN-38 CSMMT course from the total costs presented.

CGN-38 Value = (CGN-38 Development Cost plus Material Cost) 25%[1]

= (191,827 + 5,390 + (5,390 X 23.05%) + (5,390 + (5,390 X 23.05%)) (10%)) 25%

= (191,827 + 5,390 + 1,242 + 663) 25%

= 199,122 X 25%

= $ 49,780

h. TOTAL DEVELOPMENT COST = F + E + IMD + P + S + ST + M

= $701 + 0 + $6,083 + $65,068 + $644 + 0 + $49,780

TOTAL DEVELOPMENT COST = $122,276

[1] Development of these costs is described in detail in TAEG Technical Memorandum 77-5 (Cordell, Nutter, and Miller, 1977).

4. Implementation Cost Computations:

a. F = 0

b. E = 0

c. IMD = $8,210

d. P = TOTAL HOURS X AVERAGE LABOR RATE

(1) PROFESSIONAL = 2,426 HRS X $12.722/HR = $30,864

(2) CLERICAL = 0

P = $30,864

e. S = $1,258

f. ST = 0

g. M = 0

h. TOTAL IMPLEMENTATION COST = F + E + IMD + P + S + ST + M

= 0 + 0 + $8,210 + $30,864 + $1,258 + 0 + 0

TOTAL IMPLEMENTATION COST = $40,332

5. TOTAL NAVY CGN-39 CSMMT COST = DEVELOPMENT COST + IMPLEMENTATION COST

= $122,276 + $40,332

= $162,608

Comparison of the above total cost with the estimated contractor cost for the same effort led to the apparent conclusion that the Navy developed CGN-39 CSMMT was the more cost effective. The validity of this conclusion, however, had to be weighed in conjunction with the following facts:

- Navy civilian labor rates were not adjusted to reflect a burden value as were the Navy military and projected contractor labor rates.
- No monetary value was attached to the special training (i.e., the two Course Development courses) provided to Navy personnel.
- The Navy cost analysis does not address whether or not the Navy resources (personnel, facilities, services, etc.) consumed to develop and implement the CGN-39 CSMMT could have been redirected to other uses which may have made a greater contribution to the accomplishment of the Navy mission.

- Approximately 41 percent of the Navy's development costs are attributed to the real value realized from the contractor developed CGN-38 CSMMT course. This represents a significant percentage of the Navy's total development cost.

A major finding derived from the cost analyses presented in TAEG Technical Memorandum 77-5 was that each initial training case must be treated individually based on the actual events occurring in that case. The analyses performed to permit comparison of the contractor and Navy initial training costs for the CGN-38 and CGN-39 were based on a unique set of events not necessarily applicable in all acquisition programs. For instance, Navy facilities used during development of the CGN-39 CSMMT had exceeded their life expectancy and, therefore, had no monetary value. This is a unique situation that will not occur in most Navy course developments. Whereas the basic cost estimation procedures used to estimate the Navy developed initial training costs are valid, minor modifications will be required to adopt these procedures to accommodate the unique requirements and situations of individual initial training programs.

APPENDIX D

SUMMARY OF CASES STUDIED

SUMMARY OF CASES STUDIED

This appendix summarizes the data acquired for each of the cases selected for in-depth study. Through discussion with Navy personnel associated with initial training, the 14 programs listed in table D-1 were identified as candidates for case study. Five of the fourteen were selected for in-depth study. Reasons for nonselection of the remaining 9 programs are given in table D-1.

Three data elements were researched for each case: historical background, resources available to CNET at the time initial training planning commenced, and the cost of initial training. Two of the three elements are addressed for each case. The third data element, resources available to CNET at the time initial training planning commenced, was a "lost cause." In some cases resources did exist, usually in the form of personnel available to the Navy predominately at land based test sites, but they were not under CNET control. Therefore, in terms of course development, their usefulness would have been marginal at best. In one case, the 1200 PSI Simulator, an undefined quantity of personnel and facility resources were available to CNET but were not used. More importantly, however, there was no way of establishing even an approximation of the quality and quantity of resources which may have been available for diversion into the preparation for initial training without degrading other Navy requirements. For these reasons no further reference will be made to resources which might have been diverted into the development and presentation of initial training.

Data were gathered in an attempt to establish a series of historical milestone charts. These milestone charts were to be used to identify each of the major participants in the planning and preparation of initial training for each case and their points of entry into the program. The milestone chart for each case was then to be compared with a master milestone chart based on the major decision points of any acquisition. Figure D-1 is the master, relative milestone chart. It is based on current, existing directives and relates required training actions to major acquisition decision points.

The data were to be used to:

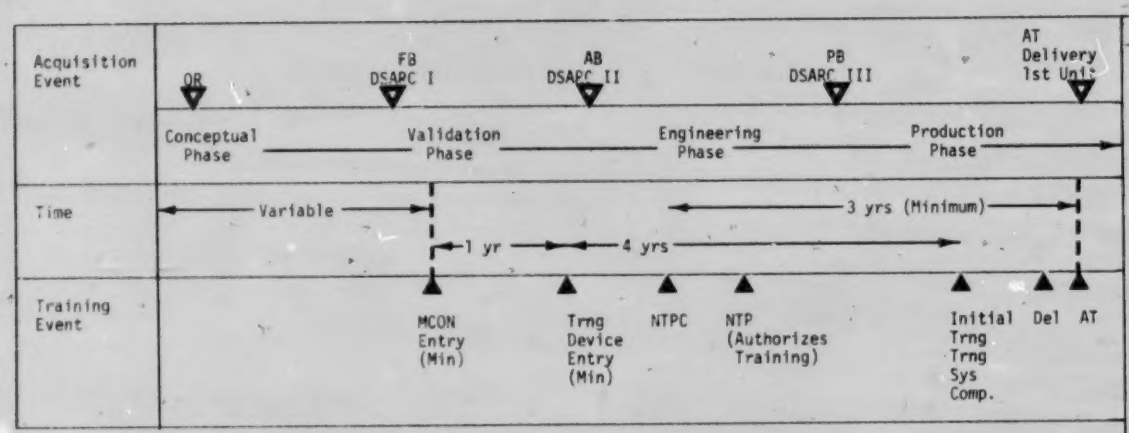
- Identify and determine the value of all elements classifiable as resources required to be expended for each of the initial training programs.
- Compare the actual timing of the Training Agent (TA) inputs in each program with the optimum timing of these inputs to determine whether maximum use was made of the training expertise available.
- Develop a cost management control procedure which could be used with the Navy cost procedure presented in TAEG Technical Memorandum 77-5 to compare the cost of using Navy provided initial training. This comparison would be one factor used by acquisition managers in making the decision respective to who is to develop initial training and who is to implement the training.

TABLE D-1. TOTAL INITIAL TRAINING CASES INVESTIGATED

SYSTEM/EQUIPMENT	INFO SOURCE	TYPE COURSE	REMARKS
CGN 38/39 - Combat System Maintenance Management	PMS - 378 OP - 992 OP - 39 COMBATSYSTRAGRU CNTECHTRA	Maintenance	Acceptable
LHA - Engineering Consolidated Control System	PMS - 377 CNTECHTRA	Maintenance	Not acceptable. Insufficient data for cost analysis. No historical data.
1200 PSI Simulator	PMS - 301 PMS - 306 SWOS, NPT NAVTRAEQUIPCEN	Operator & Maintenance	Acceptable
FFG - 7 Ship's Service Diesel Generator	PMS - 399 P.E. Sch., SSC, Great Lakes CNTECHTRA	Maintenance	Acceptable for historical purposes. Not acceptable for costing. Data not in a usable format & incomplete.
FFG - 7 GFCS MK 92	PMS - 399 NAVSEA 653 LBTS, LI, NY CNTECHTRA	Maintenance	Acceptable
CIWS System	PMS - 404 NTU CNTECHTRA	Maintenance	Not acceptable. Data could not be broken-down into increments. Historical recaps not available.
AN SPA - 48	CNTECHTRA	Maintenance	Not acceptable. Initial training will be a different course in late CY 78.

TABLE D-1. TOTAL INITIAL TRAINING CASES INVESTIGATED (continued)

SYSTEM/EQUIPMENT	INFO SOURCE	TYPE COURSE	REMARKS
Weapons Officer Course	CNTECHTRA	Operator	Not acceptable. No equipment involved. Not appropriate for this study.
MK 86 MOD 8 GFCS	CNTECHTRA	Maintenance	Not acceptable. No development effort yet for initial training.
AN/WSN-2 Gyro Compass Types I and II	NAVSEA - 047 NAVSEA - 0243 NAVSEA Plant Rep.	Maintenance	Not acceptable. Cost data not broken into categories. Single price bid made and accepted. No historical data.
AEGIS	CNTECHTRA	Maintenance	Not acceptable. A NTU has been established but has prepared no courses. Too early in program.
400 HZ Solid State Frequency Converter	NAVSEA - 047 CNTECHTRA	Maintenance	Not acceptable. Too early in program. Evaluation not scheduled until CY 79.
MK 62 MOD 16 GFCS	CNTECHTRA	Operator	Not acceptable. Initial training scheduled for late CY 78.
FFG - 7 Central Control Station	PMS - 399 CNTECHTRA	Maintenance	Not acceptable for historical purposes. No records. Acceptable for costing.



[1] Identifies fixed point in time.

OR (Operational Requirement)
FB (Functional Baseline)
AB (Allocated Baseline)
PB (Product Baseline)
AT (Acceptance Trials)
DSARC (Defense System Acquisition Review Council)
NTPC (Navy Training Plan Conference)
NTP (Navy Training Plan)
ILS (Integrated Logistic Support)
MCON (Military Construction)
DEL (Delivery)

REMARKS

1. System delivery and AT are considered to be zero time with all other time spans measured relative to this point.[1]
2. Time between the OR and approved FB at DSARC I, approved PB at DSARC III, and delivery and AT is variable from program to program.
3. Published NTP required at least 3 years prior to delivery. NTPC required to occur no more than 90 days prior to issuance of approved NTP. DRAFT NTP required to be issued at least 30 days prior to NTPC.
4. NTPC usually occurs shortly after DSARC II because, with approval of the AB, development funds are released. These funds include ILS funding of which training is a major subelement.
5. Minimum time for budgetary submissions for major training devices is 4 years prior to ready for training date.
6. Minimum time for budgetary submission for MCON is 5 years prior to beneficial occupancy date.

Figure D-1. Master Milestone Chart Showing Relationship of Major Training Decision Points to Major Acquisition Decision Points

The remainder of this appendix is devoted to the presentation of the data acquired for each case study. Each case includes a subsection on History and Initial Training Costs. Only the CGN-38/39 case study was supported with sufficient data to warrant inclusion of an analysis subsection. Data for the remaining case studies was so limited that comprehensive analysis was impossible.

CASE I. CGN 38/39 COMBAT SYSTEM MAINTENANCE MANAGEMENT (CSMM) INITIAL TRAINING

Complete details of this case study are contained in TAEG Technical Memorandum 77-5, Precommissioning Training, dated July 1977. Consequently, only a summary of relevant data will be presented here.

HISTORY. The CGN-38 Ship Class is basically a modified version of the existing DLGN 36/37 ship class which had previously been acquired by the Navy. For the CGN-38 class there was no Operational Requirement (OR) per se, nor a Defense System Acquisition Review Council (DSARC) I or II. Rather, the class was authorized by a Ship Acquisition Plan (SAP) in October 1968. DSARC III occurred in 1970, and this was followed by a DSARC IIIA in 1971. Delivery of the first ship, CGN-38, occurred in August 1976 approximately 6 years after the Production Phase had been authorized.

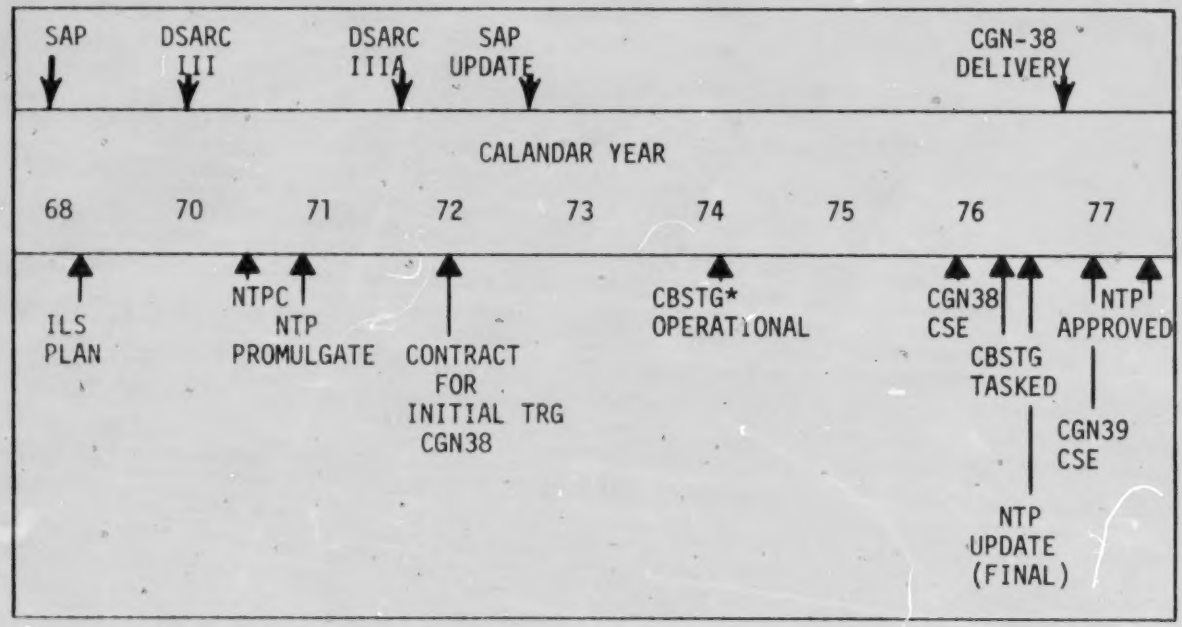
The first documented planning for an initial training course in CSMM resulted from the NTPC held in May 1970. A preliminary Navy Training Plan (NTP), which resulted from the conference, was issued in August 1970. The first approved NTP was dated May 1977. However, CSMM initial training planning for the CGN-38 Class proceeded on the basis of the preliminary NTP and its revisions. Actual initial CSMM training for the first ship was presented by the contractor during the months of October and November 1975.

The CSMM course presented by the contractor to the CGN-38 crew was not satisfactory because it lacked the depth necessary for use in CSMM. It did, however, provide useful information for system indoctrination of junior technicians. The course lacked the required depth primarily because course developers were unable to obtain data on the integration of the many sub-elements of the system controlled by the integration computer prior to completion of course development. The anticipated contractor's cost to revise this course for the second ship of the class, CGN-39, was considered to be excessive. After considering the alternatives, the Ship Acquisition Program Manager (SHAPM), who was also the Training Support Agent (TSA), requested a Navy command, the Combat System Training Group (COMBATSYSTRAGRU), to revise and present the course to the CGN-39 crew. This second course was considered to be a part of initial training since the Training Agent (TA), CNET, could not accept responsibility for CSMM training until the TSA could provide an acceptable course. The COMBATSYSTRAGRU developed and presented an acceptable course to the CGN-39 in 7 months.

The COMBATSYSTRAGRU had become operational in January 1974 for the purpose of examining the training in combat systems maintenance. As an additional duty the COMBATSYSTRAGRU prepared and evaluated a proposed new combat system organization for combatant vessels. The Group was stable from its foundation in 1974 through its disestablishment in mid-1977. When tasked

in February 1976 to develop the CGN-39 CSMM course, this group could be considered experts in the field of combat system maintenance, with more diversified experience than any other group within the Navy and probably within the industrial community. This is considered a unique situation atypical to most acquisition programs.

The milestone chart for the CGN-38/39 Initial Training, figure D-2, depicts the entry points of the various commands and critical events which occurred during the development and presentation of the CSMM training courses for the CGN-38 and CGN-39.



*CBSTG - Combat System Training Group (COMBATSYSTRAGRU)

Figure D-2. Milestone Chart for CGN-38/39 CSMM Initial Training

INITIAL TRAINING COSTS. For the CGN-39 initial training, the actual Navy costs were $162,608 against a projected contractor cost of $200,000. Thus an apparent cost avoidance of $37,392 was realized. The total program cost avoidance, however, is apparent rather than actual. First, no general and administrative cost (G&A) are included, and, second, the facilities used had exceeded their life expectancy and were scheduled to be razed; therefore, there were no Navy facility costs (other than building maintenance and operation).

Actual contractor costs for initial training presented to the CGN-38 were broken into development costs (81 percent) and implementation costs (19 percent).

A breakdown of the Navy costs indicates that the development cost for the CGN-39 course was 75 percent and the implementation cost 25 percent of the total cost. The projected contractor cost breakdown for the CGN-39 course was 79 percent for development and 21 percent for implementation. Thus, the greatest proportion of the CSMM course costs lay in the development area. Therefore, any significant cost avoidance to the Navy would lie in this area. Further examination of the development area reveals the greatest percentage of the development cost is attributable to labor effort. The Navy developed CGN-39 course required 5,025 development hours and the projected contractor hours for the CGN-39 was 7,160 hours. Thus, the Navy was expected to use 2,135 fewer hours in the development which, at an average rate (1977) of $12.65 per hour, equates to $27,000 without including G&A profit.

ANALYSIS. Over a 2 year period there had been developed within the Navy a high degree of system and equipment expertise in the area of combat systems and the maintenance of these systems. However, the integration computer for this particular combat system was new to the Navy team. Naval personnel required some contractor training and detailed documentation on the integration computer in order to become fully qualified in all aspects of system maintenance. This training and documentation were provided, and the cost is included in the development costs of the CGN-39 course. Actual course development was accomplished in 7 months by four professionals assisted by a single, part-time typist.

The CGN-38 contractor was tasked for CSMM initial training in December 1971, approximately 3-3/4 years prior to the course convening date. The training contractor was not the system designer; therefore, he was required to develop an in-house system expertise in order to prepare the course. Because the integration computer documentation was late, the training contractor was unable to provide a satisfactory initial training course. The contractor who developed and presented CGN-38 initial training was prepared to update the CGN-38 initial training course commencing approximately 9 months prior to the course convening date for the CGN-39 crew. An examination of the times involved (see figure D-2) reveals that there was adequate time for the Navy to have acquired the trained personnel to develop and present the initial training for the CGN-38 had they commenced development effort at the time the training contract was awarded. Even though the Navy developed and presented the second CSMM training course to the CGN-39 crew at a cost avoidance of 19 percent (refer to TAEG Technical Memorandum 77-5), it is not logical to assume that the Navy could have realized similar savings in the preparation and presentation of the original CGN-38 course. The rationale for this statement is based on the following intangible factors which must have been considered by the TSA in conjunction with the prospective TA. Other factors may also have had to be considered.

- The Navy's shortfall; i.e., lack of knowledge of and documentation on the integration computer, was identical to the contractor's.

- Serious consideration would have to have been given to the loss of training resources during the extended period of time required to develop and present the course. Could the training community have

afforded to assign specialists to the combat system thereby losing their services in other areas?

- Should the expertise not be available within the training community, could adequate people have been obtained for the requisite period from the operational forces without degrading operational readiness?

- This project would have required the assignment of Naval personnel well in advance of the training commencement date. Very nearly 3 years lapsed between the contract award date and the ready for training date. The sea/shore rotation policy would normally preclude retention of Naval personnel within the training command subsequent to their being trained as experts.

A comparison of actual contractor CGN-38 initial training development costs against estimated Navy development costs for the same course was desired. Unfortunately, sufficient historical Navy course development data was not available upon which to base estimates of required Navy effort. However, based on experience gained during the study and upon discussions with knowledgeable personnel, it appears likely that such a comparison would have indicated very little difference between Navy and contractor course development costs. If one presumes that this would have been the case, and considering cost alone as the determining factor, it may not have been cost effective for the Navy to develop the CGN-38 initial training. However, in terms of the solution to the personnel problems faced by acquisition managers, the potential benefits to be derived during follow-on and replacement training, and the availability of a cadre of combat systems trained specialists who could be used in subsequent ship acquisitions (for example the FFG-7 Class Ship), the acquisition manager with advice from the TA and Personnel Manager may have made the decision to use Navy personnel to perform the CGN-38 development effort.

One critical personnel rotation policy requires emphasis. In major, multi-year acquisitions, the sea/shore rotation of Naval personnel does not, normally, permit retention of the developed specialists in the training command beyond initial training. Thus, many of the intangible benefits would be lost. Two alternative solutions to this problem are presented here although other solutions may be available. These and other alternatives yet to be developed should be examined for feasibility and economic efficiency.

- Assign Navy civilian employees the task of developing the requisite expertise. In this manner the TA (CNET) would obtain and could retain a core of experts in various fields.

- Develop a career path for Naval personnel in various fields which would guarantee shore duty in the training command interspersed with operational assignments within their career field. In this way CNET would be assured of recovering expended resources used to develop experts in various fields, the person would not be denied the career enhancing assignments, and the operational forces would have available the most highly trained experts available.

CASE II. SHIP'S SERVICE DIESEL GENERATOR (SSDG)

The SSDG acquisition was a part of the total Ship Acquisition Program for the Guided Missile Frigate Class, the first of which was the USS PERRY (FFG-7). Initially, the study team attempted to regard the FFG-7 program as a unit, that is, all systems acquired by the SHAPM were to be examined as a unit of the ship initial training requirements. It became apparent that this approach was impractical; the acquisition and initial training for each equipment and system were treated independently by the SHAPM. Until ship familiarization occurred with both the nucleus and balance crews present, no attempt was made to regard initial training as other than system related. Therefore, it became necessary to treat the two cases derived from the FFG-7 acquisition program independently.

The SSDG was designed for installation in ships having a central engineering control station with no persons stationed in the machinery space. The remote control and monitor features are part of an overall plan for reduced ship manning. The maintenance concept is designed to reduce on-board maintenance to a minimum by replacing certain components before failure and by scheduling portions of normal shipboard maintenance tasks during maintenance availability periods. Organizational maintenance is confined to the Preventive Maintenance System (PMS), visual checks, and replacement of components and accessories as units or modules.

HISTORY. The program was initiated by a Top Level Requirement (TLR) in February 1971. This TLR was accepted by CNO in May 1971 which formally initiated the conceptual phase of the program. The TLR, in effect, substituted for DCP I/DSARC I. DCP II/DSARC II occurred in August 1972, and DCP III (without a DSARC III) was issued in December 1975. The approved NTP, issued in February 1975, established the training concept. Since the diesel engine portion of the diesel generator set had been in commercial use, but not Navy use, for some time, no OPEVAL or TECHEVAL was considered necessary nor was one planned. Initial training was to be confined to the diesel engine. The maintenance workload caused by the generator was considered to be so low as to impose a negligible additional workload on the ship's electricians.

The first equipment diesel was tested at the contractor's plant. It failed prior to completion of the 1,000 hours operational test required, but the failure was attributed to equipment external to the diesel engine. Pretest was not considered necessary. Subsequently, the equipment was installed at the LBTS, Philadelphia, PA, and failed to perform in this environment. As a consequence, NAVSEA required a retest by the contractor. During this retest the engine failed. There remained insufficient time for another test prior to installation aboard ship; therefore, the SSDG was installed aboard the FFG-7 without having completed the required 1,000 hours operational test.

In January 1976, the TSA (NAVSEA) tasked the Project Director (FFG Propulsion System, LBTS, PA) to develop the initial training course for the SSDG. Since follow-on and replacement training were scheduled to be taught at the Service School Command (SSC) Great Lakes, the TSA offered billets to the Training Command for instructors to attend the Initial Factory Training

course scheduled for March 1976. The intent was that these personnel would assist LBTS personnel in curriculum design. SSC personnel attended two contractor courses and, then, in July 1977 conducted an SSC developed maintenance course for the FFG-7 crew at the contractor's plant under contractor supervision. Although the SSC, Great Lakes, was not tasked to prepare a SSDG maintenance course, they did so.

The first ship of the class was delivered in June 1977. FFG-8 is scheduled for delivery in November 1979. The SSDG was required to be delivered for installation 15 months prior to the ship's delivery date, or in August 1978 for the second ship. Training for the ship's crew was scheduled to commence at SSC, Great Lakes, in September 1978 for Fleet Introduction Team (FIT) and ship's crews. However, the rebuilt engine from the LBTS was not scheduled for installation until January 1979. The major events of the SSDG program are summarized in figure D-3.

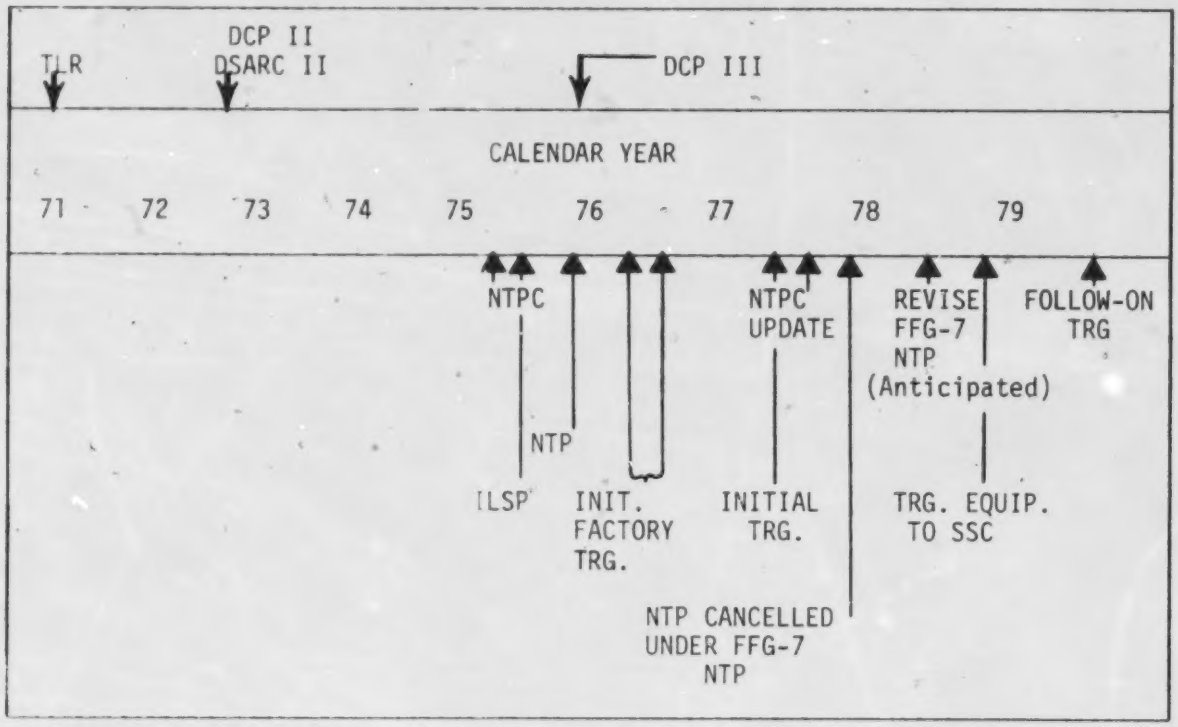


Figure D-3. Milestone Chart for SSDG Initial Training

INITIAL TRAINING COSTS. At least two training courses were given by contractors and another by Naval personnel at a contractor's facility. In all cases, cost for contractor services and facilities were covered by the basic contract and could not be isolated. Only supplies and services used in support of one of

the courses were costed separately from the basic contract. Thus, it was impossible to determine the actual contractor's costs to the Navy for SSDG initial training.

Block funding for travel and per diem was used to cover the cost of Naval personnel attending the various courses. These funds are the only identifiable direct Navy costs which could be associated with initial training. The establishment of a program at the LBTS and the contractor developed publications and material used in the courses obviously did require the expenditure of funds, but these costs are included in the basic contract and are not separately identifiable.

In the study of the SSDG it became apparent that funds were allocated for initial training; however, the source of these funds and the specific purpose for which they were used was obscured in the hardware costs. What little information was available was distributed among many commands and required an extensive investigation to locate.

CASE III. MK 92 GUN FIRE CONTROL SYSTEM (GFCS)

The FFG-7 contained a number of systems which, from a training perspective, are an essentially new technology. The Mk 92 GFCS is one of these systems. This system was selected for case study because the first ship of the class was operational, and training for its crew as well as instructors at the Navy shore school site had been completed.

HISTORY. A TLR was established for a light weight gun fire control system for the proposed hydrofoil and frigate classes of ships. Based on this requirement, a risk analysis was performed and an investigation conducted into existing systems. A Dutch system, designated in the United States as the Mk 94 GFCS, was selected as meeting all basic requirements. An operational copy of the Dutch system was brought to the United States and released to a contractor for Americanization. Because of the peculiarities of the acquisition, there was no OR, and the system did not undergo DSARC review and approval. Rather, in May 1972 a pre-production contract was let and a LBTS constructed. The Mk 94, as modified into the Mk 92 Mod 0 GFCS, was installed at the LBTS. The Navy assigned a unit to the LBTS to work with the contractor and to supervise the system modifications. This command consisted exclusively of technicians who reported to NAVSEA. None of the standard acquisition milestones (DCP, NDCP, DSARC, etc.) were identified as having been used in this acquisition.

In August 1974, based on a Fast Cruise Test at the LBTS, the Mk 92 Mod 0 GFCS was accepted for service use. A system was then installed aboard the USS TALBOT (DEG-4) for TECHEVAL/OPEVAL which was conducted during the period November 1974 - June 1975. Based on these evaluations the system received Service Approval.

A NTPC for the Mk 92 was held in August 1975. Periodic update conferences were scheduled to occur subsequently; however, no records of these conferences could be found. An NTP was issued after the first NTPC, although approval

did not occur until 1977. In June 1977, the approved NTP for the Mk 92 GFCS was incorporated into the overall FFG-7 NTP, and the Mk 92 NTP disappeared as a distinct entity.

The Mk 92 Mod 0 was not the design selected for shipboard installation. Rather the Mk 92 Mod 1 was developed for the PHM, and the Mk 92 Mod 2 system for the FFG-7 class. The additional missile control capability of the Mk 92 Mod 2 is the basic difference between the two systems. Because of the similarity of systems, the contractor developed a 28-week course--the first 20 weeks being devoted exclusively to the GFCS Mk 92 Mod 1, the remainder to the Mod 2. A series of six courses were taught during the preproduction phase. A discussion of each course in order of occurrence is presented below:

- January-August 1974 (Presented at LBTS by the contractor): Attendees were OPEVAL/TECHEVAL crew from the USS TALBOT (6 persons), PHM crew (4 persons), and LBTS personnel (6 persons). This course was not satisfactory primarily due to translation problems; i.e., much of the original Dutch material had not yet been translated; therefore, prints and wiring diagrams were often unintelligible. In addition, no signal flow-diagrams were available, little to no hands-on time on the actual equipment was scheduled, and very poor living conditions for the students existed. This course was sponsored by the SHAPM (PMS-399).

- August 1974-February 1975 (Presented at the LBTS by the contractor): This was a signal flow course covering operations, maintenance, and software for the technical ratings who were to be aboard the USS TALBOT during OPEVAL/TECHEVAL. Development was independent of the original course, and the results proved to be satisfactory. This course was sponsored by the system development code in NAVSEA and was independent of the training provided by the SHAPM.

- January-April 1977 (Presented at the LBTS by Naval personnel assigned to the site): This was the first course designed especially for the Mk 92 Mod 2 course. It was prepared and taught from the applicable Ordnance Publications (OP) by Navy technical personnel. Approximately 15 percent of the original contractor presented course (January 1974) was usable; therefore, this can be considered an independently developed course. Course content was designed for the nucleus crew of the FFG-7, a highly selected group of men. This course was sponsored by the SHAPM.

- April 1977: This course was a signal flow course of 4-5 weeks in length. It was designed as a combat systems maintenance management course to train technical personnel in the interrelationship of the various subsystems. This was a new course presented by the contractor under the sponsorship of the system development code of NAVSEA.

- April-August 1977: A course designed to teach the balance crew of the FFG-7 combat system team how to operate the Mk 92 Mod 2 system. The course was developed and presented by LBTS personnel under the sponsorship of the SHAPM.

In addition to these system level courses, there were other courses taught on the subsystem, for example, the SPS-49 radar. The actual course development and implementation was done by the contractor. The work was authorized and funded by the system development code of NAVSHIPS.

The initial version of the NTP called for the development of training course material in accordance with MIL-STD-1379(N). Subsequently, when the revised MIL-STD-1379(A) was approved, work had progressed to the point that change to the new MIL-STD-1379(A) was not cost effective. The CNTECHTRA guide, CNTECHTRA A-10, was not cited in the contract because it had not been accepted as a Navy-wide document and was not used by NAVSEA. Informal working arrangements were made whereby the contractor adhered to the requirements of MIL-STD-1379(A) as long as additional costs would not be incurred. However, contractor representatives stated that it was unrealistic to attempt to perform a task analysis in accordance with the contract schedule as there was no hardware upon which to base a task analysis. In addition, the training course material desires of the lead school differed from the stipulations of CNTECHTRA A-10, which differed from MIL-STD-1379.

Figure D-4, Milestone Chart for Mk-92 GFCS Initial Training, depicts the major operational and training events as they occurred and are anticipated to occur. Of particular note is the lack of system acquisition milestones to which requirements can be tied.

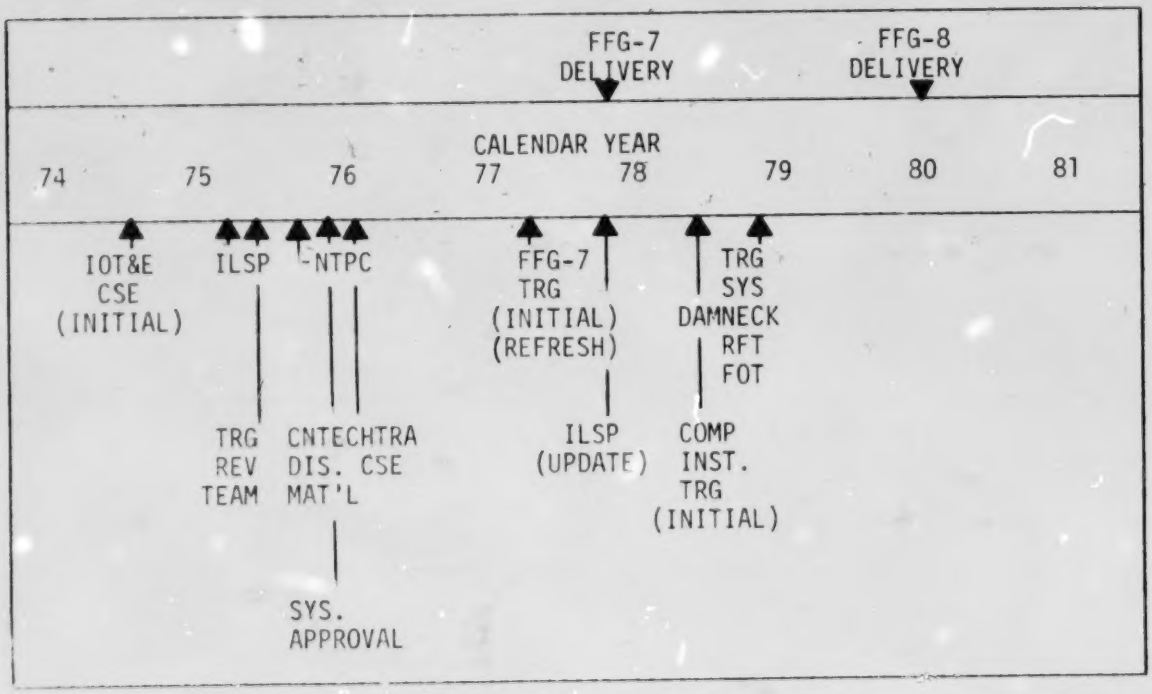


Figure D-4. Milestone Chart for Mk-92 GFCS Initial Training

CASE IV. 1200 PSI STEAM PROPULSION PLANT TRAINER (DEVICE 19E22)

The technical complexities of the systems and equipments being operated by Naval personnel are increasing, particularly in light of the automation being introduced to reduce the number of personnel required to man and operate ships. As a consequence, training has become more reliant on highly sophisticated, expensive, specialized equipments devoted solely to training. Many of these training devices are procured by one activity for use by another. Due to the technical complexities and cost of many of these devices it was deemed appropriate to investigate the initial training requirements of a sophisticated training device. The 1200 PSI Steam Propulsion Plant Trainer met established criteria and was therefore selected for study.

HISTORY. When the Navy made the decision to utilize a 1200 PSI steam system, no serious training problems were envisioned. However, initial 1200 PSI installations had proved unsatisfactory; fleet units were having serious operation and maintenance problems. At the direction of CNO, a study of this problem was made. This study culminated in the decision to construct a 1200 PSI hot plant at NTC Great Lakes to be used by the Propulsion Engineering School for training. This hot plant is in use today.

In 1971 NAVSHIPS (now NAVSEA) conducted an audit of engineering training under the Technical Audit Program. Findings of this audit resulted in the recommendation that a hot plant be installed at the Destroyer School, Newport, Rhode Island (now the Surface Warfare Officer's School). Because of the cost of a hot plant, a cost and requirements analysis was made of the hot plant vs. a simulator. Based on this analysis, CNTECHTRA, in 1973, decided to develop and procure a simulator. Funds were obtained in the FY 75 budget, and the contract was let in June 1975.

Five Navy commands were directly involved in the acquisition of this simulator. CNO (OP-39) funded the program and exercised program control. NAVSEA (PMS-301) provided the technical documentation pertaining to the operational system and served in a review, monitor, and evaluation function. The specific tasks PMS-301 was to perform were not detailed, and their records indicate their involvement commenced during the concept definition phase (April 1975). The NAVTRAEQUIPCEN was the designated development agency and provided the engineering and contractual services. However, the Software Support Plan was provided by the Naval Education and Training Support Center (NAVEDTRASUPPCEN), Atlantic. Lastly, the Surface Warfare Officer School (SWOS) Newport, provided on-site contractual supervision and developed the course to be used for follow-on training.

The simulator was procured outside of the normal acquisition cycle. Therefore, there was no OR, DCP, NDCP, or DSARC. However, all major commands having a direct interest in Device 19E22 were involved early in the program.

Initial training consisted of three courses, all developed and presented by contractor personnel:

- a computer course for a programmer/analyst and a computer specialist
- an operator/maintenance course conducted onsite
- an instructor course conducted onsite.

In addition to these courses, all prospective instructor and maintenance personnel attended the Main Propulsion Assistant Course at the SWOS.

Naval personnel at the SWOS evaluated the operating procedures for the 1200 PSI operational system in conjunction with their task of developing courseware for follow-on training. The simulator duplicated the actual equipment insofar as operating procedures are concerned and was constructed and tested at the SWOS site; therefore, the follow-on course developers at SWOS probably had a greater understanding and more knowledge of the 1200 PSI system than any other group. For this reason, it is difficult to understand their need for operator training.

The contract for the 1200 PSI Simulator was negotiated to include MIL-STD-1379(A), the only acquisition program investigated where the training package was designed in accordance with this military standard. However, the Data Item Description (DID) list omitted the three specific DIDs which specified the major difference between MIL-STD-1379 (N) and MIL-STD-1379(A). These were:

UDI-H-25522, Training Task Analysis Report

UDI-H-25523, Behavioral Objective Report

UDI-H-25524, Measurement of Student Achievement

Thus, for initial training course development there was no job task analysis required, no Specific Behavioral Objectives (SBO) developed from an analysis, and no criterion tests developed to measure student proficiency. Since device 19E22 provided a training device to support a system for which the acquisition program had been completed, it is not possible to develop a meaningful milestone chart.

INITIAL TRAINING COSTS. Reliable cost data for initial training as well as resources required were not available. Examination of available data indicated that the initial training package was approximately 3.5 percent of the total contract cost.

Overall, the contractor's cost breakdown fell into the expected pattern and within a reasonable range of the anticipated percentages for contractor developed and implemented initial training. Some discrepancies were noted, however, in labor utilization. With the Navy technicians and educators available at the SWOS, it is questionable that the operator's course was needed.

One cost item has been omitted from the total package of initial training. All personnel were required to attend the Main Propulsion Assistant (MPA)

course at SWOS. Since this was an ongoing course and required by all engineering personnel assigned to the SWOS, it was decided that the cost of attendance at the MPA course could not be attributed to the 1200 PSI simulator alone. Thus, these costs were not included.

APPENDIX E

DATA COLLECTION INSTRUMENT FOR CONTRACTOR DEVELOPED TRAINING COURSE

PRICE ANALYSIS FOR CONTRACTOR DEVELOPED TRAINING COURSE

a. PROPOSED ☐ c. DATE _____

b. NEGOTIATED ☐ d. REVISION NO. _____

Page 1

PROCURING AGENCY	ADDRESS	CONTRACTOR	ADDRESS
EQUIPMENT/SYSTEM	REP NO./CONTRACT NO.	CONTRACT ITEM NO.	
COURSE TITLE	COURSE LENGTH (WKS)	COURSE LOCATION	

1. Preparation of Course Data	Pages or Quantity	Position Title[1]	Man-Hours	Rate	Total Cost
1.1 TRAINING AND TRAINING EQUIPMENT PLAN (DI-H-6131)		XXXX	XXXX	XXX	
1.1.1 Research and Liaison	XXXX				
1.1.2 Writing and Editing	XXXX				
1.1.3 Typing					
1.1.4 Printing		XXXX	XXXX		
1.2 TRAINING COURSES AND INSTRUCTOR TRAINING SERVICES PROPOSALS (DI-P-6200)		XXXX	XXXX	XXX	
1.2.1 Research and Liaison	XXXX				
1.2.2 Writing and Editing	XXXX				
1.2.3 Typing					
1.2.4 Printing		XXXX	XXXX		
1.3 TASK AND SKILL ANALYSIS REPORT (DI-H-6130)		XXXX	XXXX	XXX	
1.3.1 Research and Liaison	XXXX				
1.3.2 Writing and Editing	XXXX				
1.3.3 Typing					
1.3.4 Printing		XXXX	XXXX		

[1] USE ONLY POSITION TITLES LISTED ON PAGE 7 OF THIS FORM. REFER TO PAGE 7 OF THIS FORM FOR ADDITIONAL INFORMATION.

1. Course Data (continued)	Pages or Quantity	Position Title	Man-Hours	Rate	Total Cost
1.4 TRAINING COURSE/CURRICULUM OUTLINES (OPTION) (DI-H-6197)		XXXX	XXXX	XXX	
1.4.1 Research and Liaison	XXXX				
1.4.2 Writing and Editing	XXXX				
1.4.3 Typing					
1.4.4 Printing		XXXX	XXXX		
1.5 TRAINING COURSE INSTRUCTOR/ LESSON GUIDES (DI-H-6198)		XXXX	XXXX	XXX	
1.5.1 Research and Liaison	XXXX				
1.5.2 Writing and Editing	XXXX				
1.5.3 Typing					
1.5.4 Printing		XXXX	XXXX		
1.6 TRAINING COURSES STUDENT'S GUIDE (DI-H-6199)		XXXX	XXXX	XXX	
1.6.1 Research and Liaison	XXXX				
1.6.2 Writing and Editing	XXXX				
1.6.3 Typing					
1.6.4 Printing		XXXX	XXXX		
1.7 TRAINING EQUIPMENT AND TRAINING COURSES AUDIO-VISUAL AIDS, MASTER REPRODUCIBLES AND REVIEW COPIES (DI-E-6124)		XXXX	XXXX	XXX	
1.7.1 Research and Liaison	XXXX				
1.7.2 Writing and Editing	XXXX				
1.7.3 Typing					
1.7.4 Printing		XXXX	XXXX		

1. Course Data (continued)	Pages or Quantity	Position Title	Man-Hours	Rate	Total Cost
1.8 TRAINING EQUIPMENT AND TRAINING COURSES AUDIO-VISUAL AIDS INDEX (DI-E-6123)		XXXX	XXXX	XXX	
1.8.1 Research and Liaison	XXXX				
1.8.2 Writing and Editing	XXXX				
1.8.3 Typing					
1.8.4 Printing		XXXX	XXXX		
1.9 MEASUREMENT OF STUDENT ACHIEVEMENT TESTS (DI-H-2033)		XXXX	XXXX	XXX	
1.9.1 Research and Liaison	XXXX				
1.9.2 Writing and Editing	XXXX				
1.9.3 Typing					
1.9.4 Printing		XXXX	XXXX		
1.10 STUDENT AND TRAINING COURSE EVALUATION FORMS (DI-P-6167)		XXXX	XXXX	XXX	
1.10.1 Research and Liaison	XXXX				
1.10.2 Writing and Editing	XXXX				
1.10.3 Typing					
1.10.4 Printing		XXXX	XXXX		
1.11 INSTRUCTOR'S SIMULATION EQUIPMENT UTILIZATION HANDBOOK (DI-H-2028)		XXXX	XXXX	XXX	
1.11.1 Research and Liaison	XXXX				
1.11.2 Writing and Editing	XXXX				
1.11.3 Typing					
1.11.4 Printing		XXXX	XXXX		

1. Course Data (continued)	Pages or Quantity	Position Title	Man-Hours	Rate	Total Cost
1.12 ON-THE-JOB TRAINING HANDBOOK (DI-H-2029)		XXXX	XXXX	XXX	
1.12.1 Research and Liaison	XXXX				
1.12.2 Writing and Editing	XXXX				
1.12.3 Typing					
1.12.4 Printing		XXXX	XXXX		
1.13 CONFERENCE AGENDA (DI-P-6202)		XXXX	XXXX	XXX	
1.13.1 Research and Liaison	XXXX				
1.13.2 Writing and Editing	XXXX				
1.13.3 Typing					
1.13.4 Printing		XXXX	XXXX		
1.14 CONFERENCE MINUTES (DI-P-6201)		XXXX	XXXX	XXX	
1.14.1 Research and Liaison	XXXX				
1.14.2 Writing and Editing	XXXX				
1.14.3 Typing					
1.14.4 Printing		XXXX	XXXX		
1.15 RESEARCH VISIT EXPENSES	XXXX	XXXX	XXXX	XXXX	
1.15.1 TRAVEL EXPENSE	XXXX	XXXX	TRIPS	P/TRIP	
1.15.2 PER DIEM EXPENSE	XXXX	XXXX	DAYS	P/DAY	
1.15.3 CAR RENTAL EXPENSE	XXXX	XXXX	DAYS	P/DAY	
1.16 OTHER (Specify)					
SUBTOTAL OF ITEM 1 UNDERLINED ITEMS		XXXX		XXX	

2. Course Material	Pages or Quantity	Position Title	Man-Hours	Rate	Total Cost
2.1 TEXT MATERIAL FOR STUDENT REFERENCE		XXXX	XXXX	XXX	
2.1.1 Preliminary Handbooks		XXXX	XXXX	XXX	
2.1.2 Other (Specify)					
2.2 TRAINING AIDS		XXXX	XXXX	XXX	
2.2.1 Labor	XXXX				
2.2.2 Material		XXXX	XXXX	XXX	
2.3 REPAIR PARTS DURING COURSE		XXXX	XXXX	XXX	
2.4 OTHER (Specify)					
SUBTOTAL OF ITEM 2 UNDERLINED ITEMS		XXXX		XXX	
3. Instructor Preparation[2] Expense					
3.1 RESEARCH AND LIAISON		XXXX	XXXX	XXX	
3.1.1 First Instructor					
3.1.2 Second Instructor					
3.2 LIAISON VISIT EXPENSE		XXXX	XXXX	XXX	
3.2.1 Per Diem Expense		XXXX	Days	P/Day	
3.2.2 Travel Expense		XXXX	Trips	P/Trip	
3.2.3 Car Rental Expense		XXXX	Days	P/Day	
3.3 OTHER (Specify)					
SUBTOTAL OF ITEM 3 UNDERLINED ITEMS		XXXX		XXX	

[2] INCLUDES ONLY THOSE EXPENSES INCURRED TO PREPARE FOR COURSE PRESENTATION, DOES NOT INCLUDE COURSE DEVELOPMENT EXPENSES.

4. Course Presentation Expense	Pages or Quantity	Position Title	Man-Hours	Rate	Total Cost
4.1 INSTRUCTORS SALARIES	XXXX	XXXX	XXXX	XXX	
4.1.1 First Instructor	XXXX				
4.1.2 Second Instructor	XXXX				
4.1.3 Per Diem Expense	XXXX	XXXX	Days	P/Day	
4.1.4 Travel Expense	XXXX	XXXX	Trips	P/Trip	
4.1.5 Car Rental Expense	XXXX	XXXX	Days	P/Day	
4.1.6 Other (Specify)	XXXX	XXXX			
4.2 OPERATORS SALARIES	XXXX	XXXX	XXXX	XXX	
4.2.1 First Operator	XXXX				
4.2.2 Second Operator	XXXX				
4.2.3 Per Diem Expense	XXXX	XXXX	XXXX		
4.2.4 Travel Expense	XXXX	XXXX	Trips	P/Trip	
4.2.5 Car Rental Expense	XXXX	XXXX	Days	P/Day	
4.2.6 Other (Specify)	XXXX				
SUBTOTAL OF ITEM 4 UNDERLINED ITEMS	XXXX	XXXX		XXX	
5. General	XXXX	XXXX	XXXX	XXXX	XXXX
5.1 GENERAL AND ADMINISTRATIVE	XXXX	XXXX	XXXX	%	
5.2 OVERHEAD	XXXX	XXXX	XXXX	%	
5.3 PROFIT	XXXX	XXXX	XXXX	%	
SUBTOTAL OF ITEM 5 UNDERLINED ITEMS	XXXX	XXXX	XXXX	XXX	

	Pages or Quantity	Position Title	Man-Hours	Rate	Total Cost
6. Total Training Course Cost (Sum of Items 1, 2, 3, 4, & 5 Subtotals)		XXXX		XXX	

NOTE: For purposes of standardization, the preparer of this form is requested to use only the position titles included in the Labor Summary below (to be completed by the contractor) in classifying personnel assigned to the training course program. Contractor position titles will not in all cases be the same as those listed below. In these cases, the most appropriate position title listed in the Labor Summary will be used and a brief explanation provided under the Remarks Section, if necessary.

LABOR SUMMARY		
Position Title	Development Hours (1 & 2)	Presentation Hours (3 & 4)
1. Manager/Supervisor		
2. Training Specialist		
3. Engineer		
4. Senior Engineer		
5. Typist/Clerical		
6. Instructor		
7. Senior Instructor		
8. Technical Writer		
9. Illustrator/Draftsman		
10. Technician		
TOTAL		

REMARKS:

APPENDIX F

COST MANAGEMENT CONTROL PROCEDURE DATA SUMMARY

COST DATA DATA SUMMARY

Expence Catagory	COURSE A (40 HOURS)					COURSE B (440 HOURS)					COURSE D (480 HOURS)					COURSE E (80 HOURS)				
	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL
	Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour	
MANGER	11.6	30	11.8	3	385	11.4	305	11.8	52	4110	9.1	17	--	--	156	--	--	--	--	0
TRAINING SPEC.	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
ENGINEER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
S. ENGINEER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
TYPIST	4.5	82	4.6	6	400	4.4	654	4.6	132	3535	4.4	417	--	--	1851	4.0	77	--	--	308
INSTRUCTOR	8.7	200	8.9	40	2104	8.5	2180	8.9	440	22624	6.9	2002	7.5	1050	21709	--	--	--	--	0
S. INSTRUCTOR	11.6	200	11.8	40	2807	11.4	2185	11.8	440	30249	--	--	--	--	0	10.5	291	10.5	104	4167
TECH. WRITER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	6.7	105	--	--	706
ILLUSTRATOR	--	--	--	--	0	--	--	--	--	0	6.5	124	--	--	814	--	--	--	--	0
MATERIALS					00229					05440					03279					01134
TRAVEL					00750					08888					06860					--
TOTAL HOURS		512		89	601		5324		1064	6388		2560		1050	3610		473		104	577

Administrative Costs	COURSE A (40 HOURS)		COURSE B (440 HOURS)		COURSE D (480 HOURS)		COURSE E (80 HOURS)	
	Rate	TOTAL	Rate	TOTAL	Rate	TOTAL	Rate	TOTAL
OVERHEAD	67.6	3851	68.2	41275	85.9	21073	87.4	4528
G & A	10.1	1063	10.1	11728	26.0	14493	40.6	4427
PROFIT	10.0	1159	10.0	12785	12.0	8428	23.5	3603

Expence Catagory	COURSE A (40 HOURS)			COURSE B (440 HOURS)			COURSE D (480 HOURS)			COURSE E (80 HOURS)		
	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost
MANGER	000349	035	385	003492	0618	4110	000156		156	--	--	0
TRAINING SPEC.	--	--	0	--	--	0	--	--	0	--	--	0
ENGINEER	--	--	0	--	--	0	--	--	0	--	--	0
S. ENGINEER	--	--	0	--	--	0	--	--	0	--	--	0
TYPIST	000372	027	400	002923	0612	3535	001851	-	1851	000308		308
INSTRUCTOR	001748	0356	2104	018704	03920	22624	013813	07896	21709	--	--	0
S. INSTRUCTOR	002332	0475	2807	025018	05231	30249	--	--	0	003070	1097	4167
TECH. WRITER	--	--	0	--	--	0	--	--	0	000706		706
ILLUSTRATOR	--	--	0	--	--	0	000814		814	--	--	0
T O T A L S	4802	895	5697	50138	10382	60521	16636	7896	24532	4084	1097	5181
G R A N D T O T A L S			12750			140638			78665			18935

COST DATA DATA SUMMARY

Expence Catagory	COURSE H (80 HOURS)					COURSE I (240 HOURS)					COURSE J (480 HOURS)					COURSE K (80 HOURS)				
	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL
	Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour	
MANGER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	15.7	18	--	--	283
TRAINING SPEC.	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
ENGINEER	9.0	404	--	--	3648	9.0	714	--	--	6447	9.0	1397	--	--	12614	--	--	--	--	0
S. ENGINEER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
TYPIST	4.2	553	--	--	2350	--	--	--	--	0	--	--	--	--	0	5.4	110	--	--	594
INSTRUCTOR	--	--	9.0	160	1444	9.0	480	9.0	480	8668	9.0	960	9.0	960	17337	10.7	320	--	--	3427
S. INSTRUCTOR	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	14.8	1046	14.9	80	16761
TECH. WRITER	9.0	822	--	--	7422	9.0	238	--	--	2149	9.0	740	--	--	6682	--	--	--	--	0
ILLUSTRATOR	9.0	35	--	--	316	9.0	105	--	--	948	9.0	210	--	--	1896	--	--	--	--	0
MATERIALS					03060					03849					06636					01423
TRAVEL					01070					04020					06640					--
TOTAL HOURS		1814		160	1974		1537		480	2017		3307		960	4267		1494		80	1574

Administrative Costs	COURSE H (80 HOURS)		COURSE I (240 HOURS)		COURSE J (480 HOURS)		COURSE K (80 HOURS)	
	Rate	TOTAL	Rate	TOTAL	Rate	TOTAL	Rate	TOTAL
OVERHEAD	81.6	12388	100.0	18213	100.0	38531	57.4	12091
G & A	10.0	3170	09.1	4030	10.0	9033	11.5	3976
PROFIT	07.4	2580	07.3	3527	08.0	7949	15.0	5783

Expence Catagory	COURSE H (80 HOURS)			COURSE I (240 HOURS)			COURSE J (480 HOURS)			COURSE K (80 HOURS)		
	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost
MANGER	--	--	0	--	--	0	--	--	0	000283		283
TRAINING SPEC.	--	--	0	--	--	0	--	--	0	--	--	0
ENGINEER	003648	-	3648	006447	-	6447	012614	--	12614	--	--	0
S. ENGINEER	--	--	0	--	--	0	--	--	0	--	--	0
TYPIST	002350	-	2350	--	--	0	--	--	0	000594		594
INSTRUCTOR	--	1444	1444	004334	4334	8668	008668	8668	17337	003427	-	3427
S. INSTRUCTOR	--	--	0	--	--	0	--	--	0	015564	01196	16761
TECH. WRITER	007422	-	7422	002149	-	2149	006682	-	6682	--	--	0
ILLUSTRATOR	000316		316	000948		948	001896	-	1896	--	--	0
TOTALS	13737	1444	15181	13879	4334	18213	29862	8668	38531	19869	1196	21065

GRAND TOTALS	37450	51854	107321	44341

COST DATA DATA SUMMARY

Expence Catagory	COURSE L (160 HOURS)																					
	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL	Develmnt		Implemnt		TOTAL
	Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour		Rate	Hour	Rate	Hour	
MANGER	15.7	12	--	--	189	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
TRAINING SPEC.	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
ENGINEER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
S. ENGINEER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
TYPIST	5.4	107	--	--	577	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
INSTRUCTOR	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
S. INSTRUCTOR	15.2	1684	14.9	160	27990	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
TECH. WRITER	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
ILLUSTRATOR	10.7	240	--	--	2570	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
MATERIALS					00752					--					--					--
TRAVEL					--					--					--					--
TOTAL HOURS		2043		160	2203		0		0	0		0		0	0		0		0	0

Administrative Costs	COURSE L (160 HOURS)							
	Rate	TOTAL	Rate	TOTAL	Rate	TOTAL	Rate	TOTAL
OVERHEAD	66.2	20738	--	0	--	0	--	0
G & A	11.4	6021	--	0	--	0	--	0
PROFIT	15.0	8825	--	0	--	0	--	0

Expence Catagory	COURSE L (160 HOURS)																			
	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost	Develmnt Labor Cost	Implmnt Labor Cost	TOTAL Labor Cost
MANGER	000189		189	--	--	0	--	--	0	--	--	0	--	--	0
TRAINING SPEC.	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
ENGINEER	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
S. ENGINEER	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
TYPIST	000577		577	--	--	0	--	--	0	--	--	0	--	--	0
INSTRUCTOR	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
S. INSTRUCTOR	025596	02393	27990	--	--	0	--	--	0	--	--	0	--	--	0
TECH. WRITER	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
ILLUSTRATOR	002570	-	2570	--	--	0	--	--	0	--	--	0	--	--	0
T O T A L S	28934	2393	31327	0	0	0	0	0	0	0	0	0	0	0	0

G R A N D T O T A L S	67665		1	1

COST DATA DATA SUMMARY

Data Break Down by Expence Catagory

MANGER	Cost	TRAINING SPEC.	Cost	ENGINEER	Cost
COURSE A (40 HOURS)	385	COURSE A (40 HOURS)	0	COURSE A (40 HOURS)	0
COURSE B (440 HOURS)	4110	COURSE B (440 HOURS)	0	COURSE B (440 HOURS)	0
COURSE D (480 HOURS)	156	COURSE D (480 HOURS)	0	COURSE D (480 HOURS)	0
COURSE E (80 HOURS)	0	COURSE E (80 HOURS)	0	COURSE E (80 HOURS)	0
COURSE H (80 HOURS)	0	COURSE H (80 HOURS)	0	COURSE H (80 HOURS)	3648
COURSE I (240 HOURS)	0	COURSE I (240 HOURS)	0	COURSE I (240 HOURS)	6447
COURSE J (480 HOURS)	0	COURSE J (480 HOURS)	0	COURSE J (480 HOURS)	12614
COURSE K (80 HOURS)	283	COURSE K (80 HOURS)	0	COURSE K (80 HOURS)	0
COURSE L (160 HOURS)	180	COURSE L (160 HOURS)	0	COURSE L (160 HOURS)	0
TOTAL COST	5124	TOTAL COST	0	TOTAL COST	22710

S. ENGINEER	Cost	TYPIST	Cost	INSTRUCTOR	Cost
COURSE A (40 HOURS)	0	COURSE A (40 HOURS)	400	COURSE A (40 HOURS)	2104
COURSE B (440 HOURS)	0	COURSE B (440 HOURS)	3535	COURSE B (440 HOURS)	22624
COURSE D (480 HOURS)	0	COURSE D (480 HOURS)	1851	COURSE D (480 HOURS)	21703
COURSE E (80 HOURS)	0	COURSE E (80 HOURS)	308	COURSE E (80 HOURS)	0
COURSE H (80 HOURS)	0	COURSE H (80 HOURS)	2350	COURSE H (80 HOURS)	1444
COURSE I (240 HOURS)	0	COURSE I (240 HOURS)	0	COURSE I (240 HOURS)	8668
COURSE J (480 HOURS)	0	COURSE J (480 HOURS)	0	COURSE J (480 HOURS)	17337
COURSE K (80 HOURS)	0	COURSE K (80 HOURS)	594	COURSE K (80 HOURS)	3427
COURSE L (160 HOURS)	0	COURSE L (160 HOURS)	577	COURSE L (160 HOURS)	0
TOTAL COST	0	TOTAL COST	9617	TOTAL COST	77317

S. INSTRUCTOR	Cost	TECH. WRITER	Cost	ILLUSTRATOR	Cost
COURSE A (40 HOURS)	2807	COURSE A (40 HOURS)	0	COURSE A (40 HOURS)	0
COURSE B (440 HOURS)	30249	COURSE B (440 HOURS)	0	COURSE B (440 HOURS)	0
COURSE D (480 HOURS)	0	COURSE D (480 HOURS)	0	COURSE D (480 HOURS)	814
COURSE E (80 HOURS)	4167	COURSE E (80 HOURS)	706	COURSE E (80 HOURS)	0
COURSE H (80 HOURS)	0	COURSE H (80 HOURS)	7422	COURSE H (80 HOURS)	316
COURSE I (240 HOURS)	0	COURSE I (240 HOURS)	2149	COURSE I (240 HOURS)	948
COURSE J (480 HOURS)	0	COURSE J (480 HOURS)	6682	COURSE J (480 HOURS)	1896
COURSE K (80 HOURS)	16761	COURSE K (80 HOURS)	0	COURSE K (80 HOURS)	0
COURSE L (160 HOURS)	27990	COURSE L (160 HOURS)	0	COURSE L (160 HOURS)	2570
TOTAL COST	81976	TOTAL COST	16960	TOTAL COST	6545

COST DATA SUMMARY DATA --- FIGURE 1.0

Expence Catagory	COURSE A (40 HOURS)		COURSE B (440 HOURS)		COURSE D (480 HOURS)		COURSE E (80 HOURS)	
	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost
LABOR	44.68 %	5697	43.03 %	60521	31.18 %	24532	27.36 %	5181
OVERHEAD	30.20 %	3851	29.34 %	41275	26.78 %	21073	23.91 %	4528
G & A	8.33 %	1063	8.33 %	11728	18.42 %	14493	23.38 %	4427
PROFIT	9.09 %	1159	9.09 %	12785	10.71 %	8428	19.02 %	3603
MATERIALS	1.79 %	229	3.86 %	5440	4.16 %	3279	6.30 %	1194
TRAVEL	5.88 %	750	6.31 %	8888	8.72 %	6860	0.00 %	0
T O T A L S	100.00 %	12750	100.00 %	140638	100.00 %	78665	100.00 %	18935

Expence Catagory	COURSE H (80 HOURS)		COURSE I (240 HOURS)		COURSE J (480 HOURS)		COURSE K (80 HOURS)	
	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost
LABOR	40.53 %	15181	35.12 %	18213	35.90 %	38531	47.50 %	21065
OVERHEAD	33.07 %	12388	35.12 %	18213	35.90 %	38531	27.27 %	12091
G & A	8.46 %	3170	7.77 %	4030	8.41 %	9033	8.96 %	3976
PROFIT	6.89 %	2580	6.80 %	3527	7.40 %	7949	13.04 %	5783
MATERIALS	8.17 %	3060	7.42 %	3849	6.18 %	6636	3.20 %	1423
TRAVEL	2.85 %	1070	7.75 %	4020	6.18 %	6640	0.00 %	0
T O T A L S	100.00 %	37450	100.00 %	51854	100.00 %	107321	100.00 %	44341

Expence Catagory	COURSE L (160 HOURS)							
	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost	Percent of Total	TOTAL Cost
LABOR	46.29 %	31327	0.00 %	0	0.00 %	0	0.00 %	0
OVERHEAD	30.64 %	20738	0.00 %	0	0.00 %	0	0.00 %	0
G & A	8.89 %	6021	0.00 %	0	0.00 %	0	0.00 %	0
PROFIT	13.04 %	8825	0.00 %	0	0.00 %	0	0.00 %	0
MATERIALS	1.11 %	752	0.00 %	0	0.00 %	0	0.00 %	0
TRAVEL	0.00 %	0	0.00 %	0	0.00 %	0	0.00 %	0
T O T A L S	100.00 %	67665	100.00 %	1	100.00 %	1	100.00 %	1

COST DATA SUMMARY DATA -- FIGURE 1.0

Statisicis Summary	Mean Cost	Std. Dev.	Range	Frequencies (x1000) (cost)												
				0-.5	.6-.7	.8- 1	2-3	4-5	6-7	8-9	10-19	20-29	30-39	40-49	50-59	60-99
LABOR	24472	17341.62	5181 - 60521	0	0	0	0	2	0	0	2	2	2	0	0	1
OVERHEAD	19188	13302.22	3851 - 41275	0	0	0	1	1	0	0	3	2	1	1	0	0
G & A	6438	4405.29	1063 - 14493	0	0	1	2	2	1	1	2	0	0	0	0	0
PROFIT	6071	3720.05	1159 - 12785	0	0	1	3	1	1	2	1	0	0	0	0	0
MATERIALS	2873	2188.40	229 - 6636	1	1	2	3	1	1	0	0	0	0	0	0	0
TRAVEL	3136	3526.29	0 - 8888	3	1	1	0	1	2	1	0	0	0	0	0	0

COST DATA SUMMARY DATA --- FIGURE 2.0

Expence Catagory	COURSE A (40 HOURS)			COURSE B (440 HOURS)			COURSE D (480 HOURS)			COURSE L (80 HOURS)		
	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours
MANGER	0.82 :1	33	5.49 %	0.81 :1	357	5.58 %	0.03 :1	17	0.47 %	0.00 :1	0	0.00 %
TRAINING SPEC.	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
ENGINEER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
S. ENGINEER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
TYPIST	2.20 :1	88	14.64 %	1.78 :1	786	12.30 %	0.86 :1	417	11.55 %	0.96 :1	77	13.34 %
INSTRUCTOR	6.00 :1	240	39.93 %	5.95 :1	2620	41.01 %	6.35 :1	3052	84.54 %	0.00 :1	0	0.00 %
S. INSTRUCTOR	6.00 :1	240	39.93 %	5.96 :1	2625	41.09 %	0.00 :1	0	0.00 %	4.93 :1	395	68.45 %
TECH. WRITER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	1.31 :1	105	18.19 %
ILLUSTRATOR	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.25 :1	124	3.43 %	0.00 :1	0	0.00 %
T O T A L S	15.02 :1	601	100.00 %	14.51 :1	6388	100.00 %	7.52 :1	3610	100.00 %	7.21 :1	577	100.00 %

Expence Catagory	COURSE H (80 HOURS)			COURSE I (240 HOURS)			COURSE J (480 HOURS)			COURSE K (80 HOURS)		
	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours
MANGER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.22 :1	18	1.14 %
TRAINING SPEC.	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
ENGINEER	5.05 :1	404	20.46 %	2.97 :1	714	35.39 %	2.91 :1	1397	32.73 %	0.00 :1	0	0.00 %
S. ENGINEER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
TYPIST	6.91 :1	553	28.01 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	1.37 :1	110	6.98 %
INSTRUCTOR	2.00 :1	160	8.10 %	4.00 :1	960	47.53 %	4.00 :1	1920	44.99 %	4.00 :1	320	20.33 %
S. INSTRUCTOR	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	14.07 :1	1126	71.53 %
TECH. WRITER	10.27 :1	822	41.64 %	0.99 :1	238	11.79 %	1.54 :1	740	17.34 %	0.00 :1	0	0.00 %
ILLUSTRATOR	0.43 :1	35	1.77 %	0.43 :1	105	5.20 %	0.43 :1	210	4.92 %	0.00 :1	0	0.00 %
T O T A L S	24.67 :1	1974	100.00 %	8.40 :1	2017	100.00 %	8.88 :1	4267	100.00 %	19.67 :1	1574	100.00 %

COST DATA SUMMARY DATA -- FIGURE 2.0

Expence Catagory	COURSE L (160 HOURS)														
	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours	Labor Hours Per 1 Instrctn Hour	Total Labor Hours	Percent of Total Labor Hours
MANGER	0.07 :1	12	0.54 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
TRAINING SPEC.	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
ENGINEER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
S. ENGINEER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
TYPIST	0.66 :1	107	4.85 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
INSTRUCTOR	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
S. INSTRUCTOR	11.52 :1	1844	83.70 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
TECH. WRITER	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
ILLUSTRATOR	1.50 :1	240	10.89 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %	0.00 :1	0	0.00 %
T O T A L S	13.76 :1	2203	100.00 %	0.00 :1	0	100.00 %	0.00 :1	0	100.00 %	0.00 :1	0	100.00 %	0.00 :1	0	100.00 %

Statisics Summary	Mean	Std. Dev.	Range	Frequencies (x .001)											
				0-.5	.6-.7	.8- 1	2-3	4-5	6-7	8-9	10-19	20-29	30-39	40-49	50-59	60-99
MANGER	0.21908	0.347212	0.00 - 0.825	5	1	0	1	0	0	2	0	0	0	0	0	0
TRAINING SPEC.	0.00000	0.000000	0.00 - 0.000	9	0	0	0	0	0	0	0	0	0	0	0	0
ENGINEER	1.21504	1.921477	0.00 - 5.050	6	0	0	0	0	0	0	0	2	0	0	1	0
S. ENGINEER	0.00000	0.000000	0.00 - 0.000	9	0	0	0	0	0	0	0	0	0	0	0	0
TYPIST	1.64154	2.108934	0.00 - 6.912	2	0	0	0	0	1	2	2	1	0	0	0	1
INSTRUCTOR	3.59031	2.446207	0.00 - 6.358	2	0	0	0	0	0	0	0	1	0	3	1	2
S. INSTRUCTOR	4.72260	5.317137	0.00 - 14.075	4	0	0	0	0	0	0	0	0	0	1	1	3
TECH. WRITER	1.56898	3.326091	0.00 - 10.275	5	0	0	0	0	0	1	2	0	0	0	0	1
ILLUSTRATOR	0.34120	0.473936	0.00 - 1.500	4	0	0	1	3	0	0	1	0	0	0	0	0

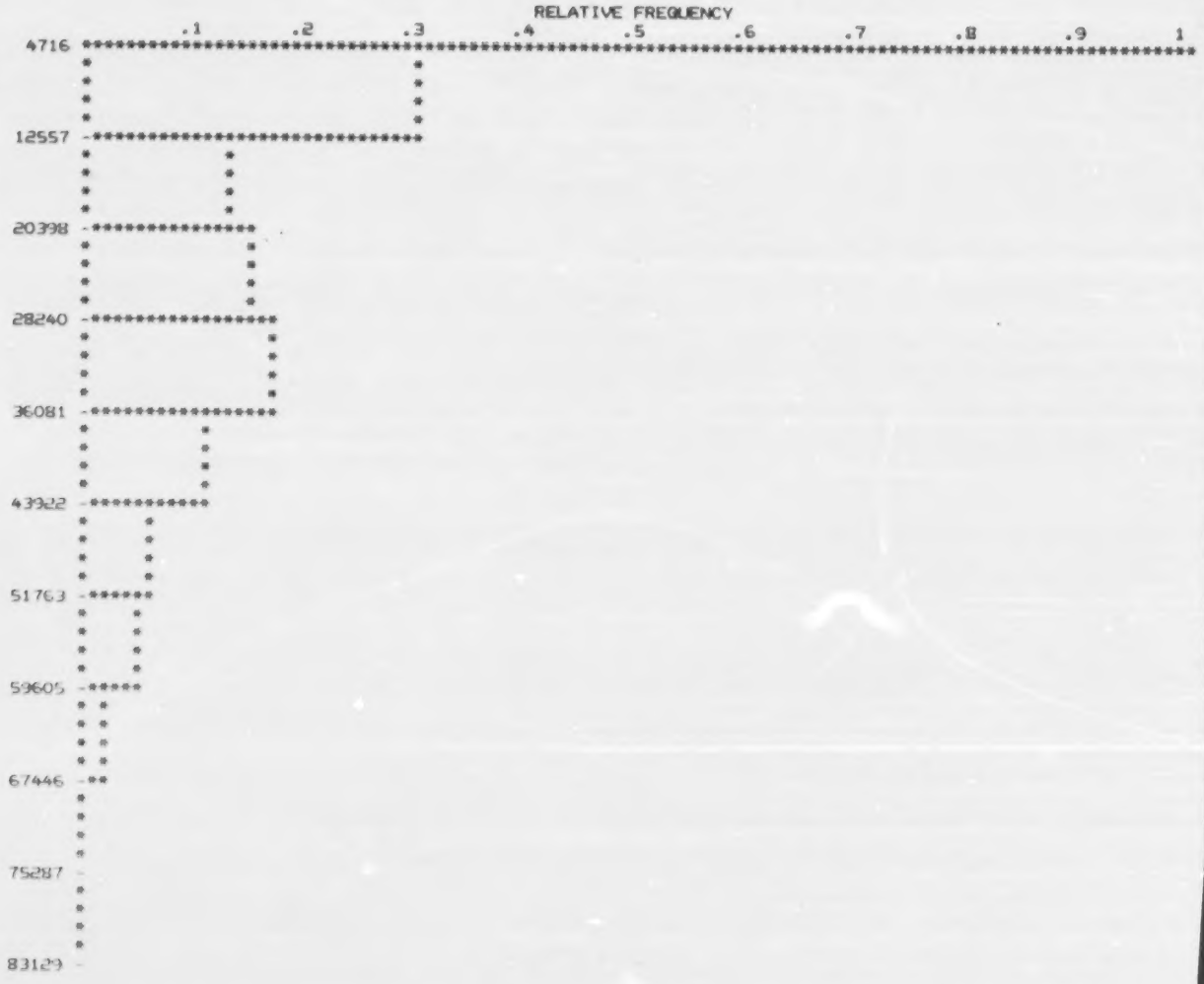
COST DATA DATA SUMMARY FIGURE 3.0 & 4.0

Course	Delvmnt Labor Hours	Implmntn Labor Hours	TOTAL Labor Hours	Instructn Hours	Percent Devlmnt of Total	Percent Implmntn of Total	Devlmnt Hrs per Instructn Hour	Implmntn Hrs per Instructn Hour	Labor Costs per Instructn Hour	System Costs per Instructn Hour
COURSE A (40 HOURS)	512	89	601	40	85.19 %	14.80 %	12.800 :1	2.225 :1	142.43 :1	318.76 :1
COURSE B (440 HOURS)	5324	1064	6388	440	83.34 %	16.65 %	12.100 :1	2.418 :1	137.54 :1	319.63 :1
COURSE D (480 HOURS)	2560	1050	3610	480	70.91 %	29.08 %	5.333 :1	2.187 :1	51.10 :1	163.88 :1
COURSE E (80 HOURS)	473	104	577	80	81.97 %	18.02 %	5.912 :1	1.300 :1	64.77 :1	236.69 :1
COURSE H (80 HOURS)	1814	160	1974	80	91.89 %	8.10 %	22.675 :1	2.000 :1	189.77 :1	468.13 :1
COURSE I (240 HOURS)	1537	480	2017	240	76.20 %	23.79 %	6.404 :1	2.000 :1	75.88 :1	216.06 :1
COURSE J (480 HOURS)	3307	960	4267	480	77.50 %	22.49 %	6.889 :1	2.000 :1	80.27 :1	223.58 :1
COURSE K (80 HOURS)	1494	80	1574	80	94.91 %	5.08 %	18.675 :1	1.000 :1	263.32 :1	554.26 :1
COURSE L (160 HOURS)	2043	160	2203	160	92.73 %	7.26 %	12.768 :1	1.000 :1	195.79 :1	422.91 :1

Statistcis Summary	Mean	Std. Dev.	Range
DEVELPMENT HOURS	2118.2222	1493.3066	473.0000 - 5324.0000
IMPLEMNTN HOURS	460.7777	440.4667	80.0000 - 1064.0000
DEVELPMENT HOURS .VS. INSTRUCTN HRS	11.5064	6.0878	5.3333 - 22.6750
IMPLMNTATN HOURS .VS. INSTRUCTN HRS	1.7922	0.5434	1.0000 - 2.4181
LABOR COSTS .VS. INSTRUCTN HRS	133.4364	72.1648	51.1083 - 263.3247
SYSTEM COSTS .VS. INSTRUCTN HRS	324.8819	131.6302	163.8874 - 554.2662

Breakdown	Range		Probability	Cost at Least	Probability
	Low	High			
1	4716	12557	0.303000	4716	1.000000
2	12557	20398	0.135000	12557	0.697000
3	20398	28240	0.149000	20398	0.562000
4	28240	36081	0.170000	28240	0.413000
5	36081	43922	0.108000	36081	0.243000
6	43922	51763	0.060000	43922	0.135000
7	51763	59605	0.051000	51763	0.075000
8	59605	67446	0.019000	59605	0.024000
9	67446	75287	0.005000	67446	0.005000
10	75287	83129	0.000000	75287	0.000000

Statisicis Summary	
Mean	24472.5033
Standard Deviation	15755.4367
Expected Value	0.0000
Simulation Mean	24760.1354
Simulation Standard Deviation	16125.5451
Number of Iterations	1000


RELATIVE FREQUENCY
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.4
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.6
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67446
75287
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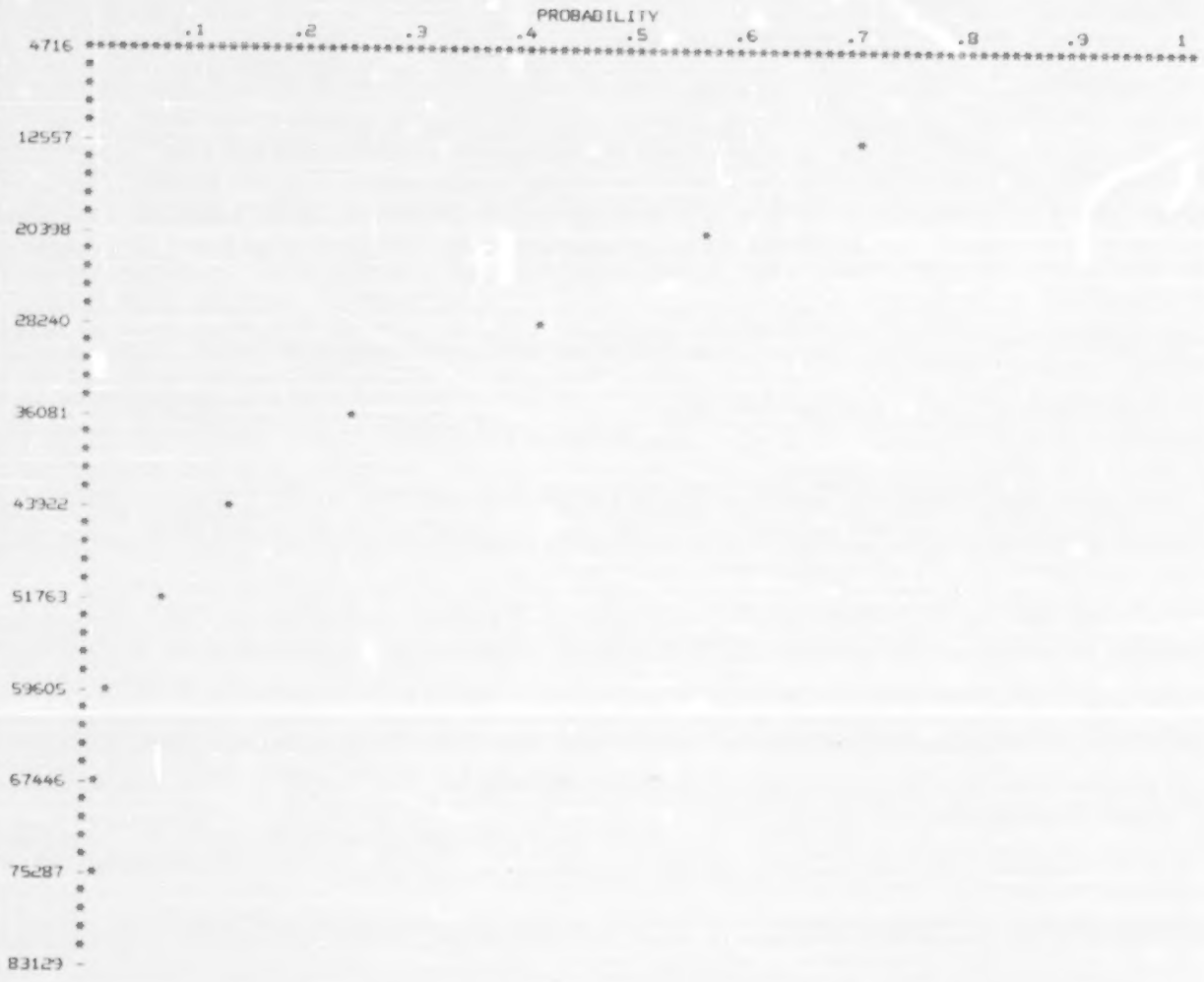
PROBABILITY
.1
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.8
.9
1
4716
12557
20398
28240
36081
43922
51763
59605
67446
75287
83129

APPENDIX G

CGN-38 CASE STUDY, CSMM TRAINING COURSE COST DATA PRESENTATION

91

Figure G-1. CGN-38 CSMMT Course, Cost Per Instruction Hour and Percent Cost of Total Contract Cost by Major Contract Cost Category

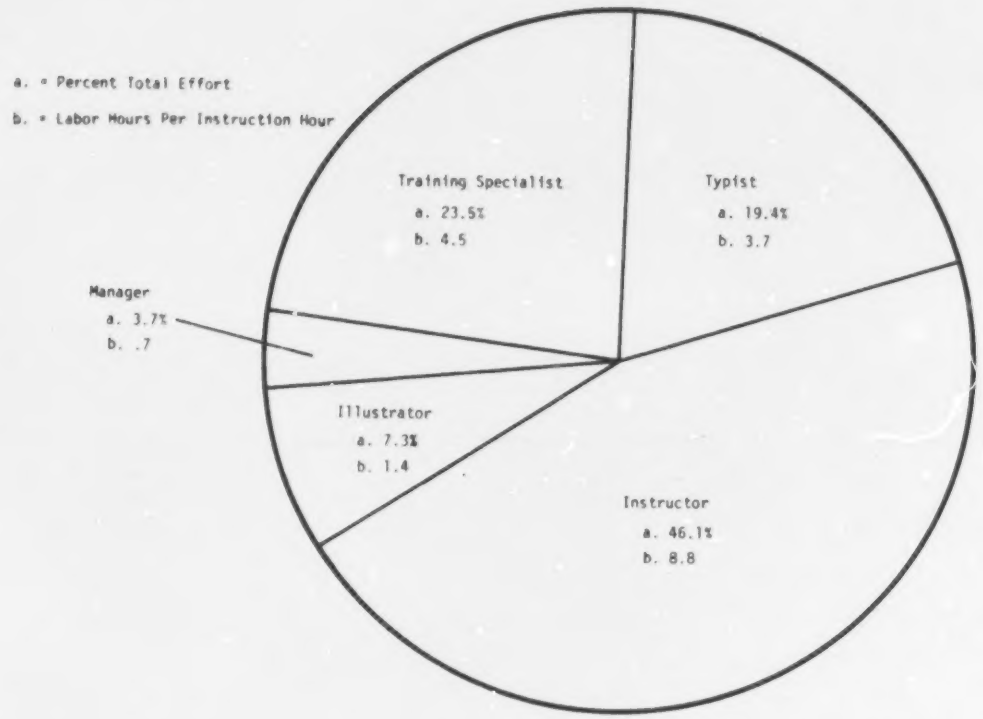

Figure G-2A. Total Labor
(19.1 Hrs/In.Hr.)

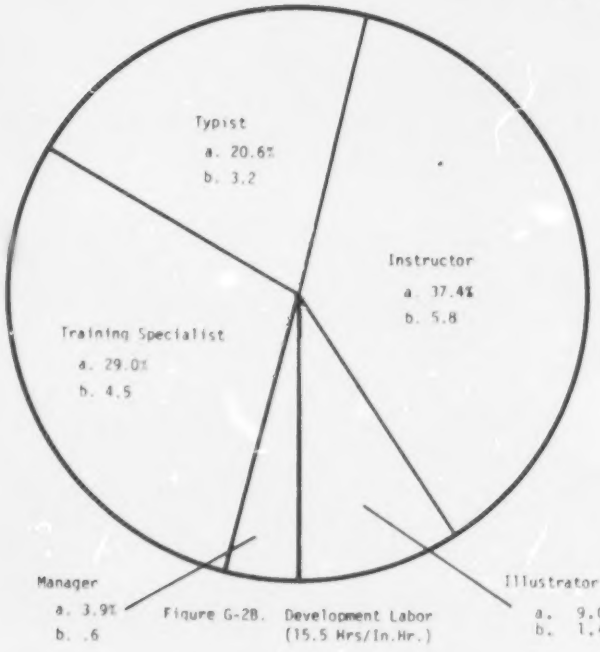

Figure G-2B. Development Labor
(15.5 Hrs/In.Hr.)

Figure G-2C. Implementation Labor
(3.6 Hrs/In.Hr.)

Figure G-2. Summary of CGN-38 CSMMT Labor Effort by Labor Classification

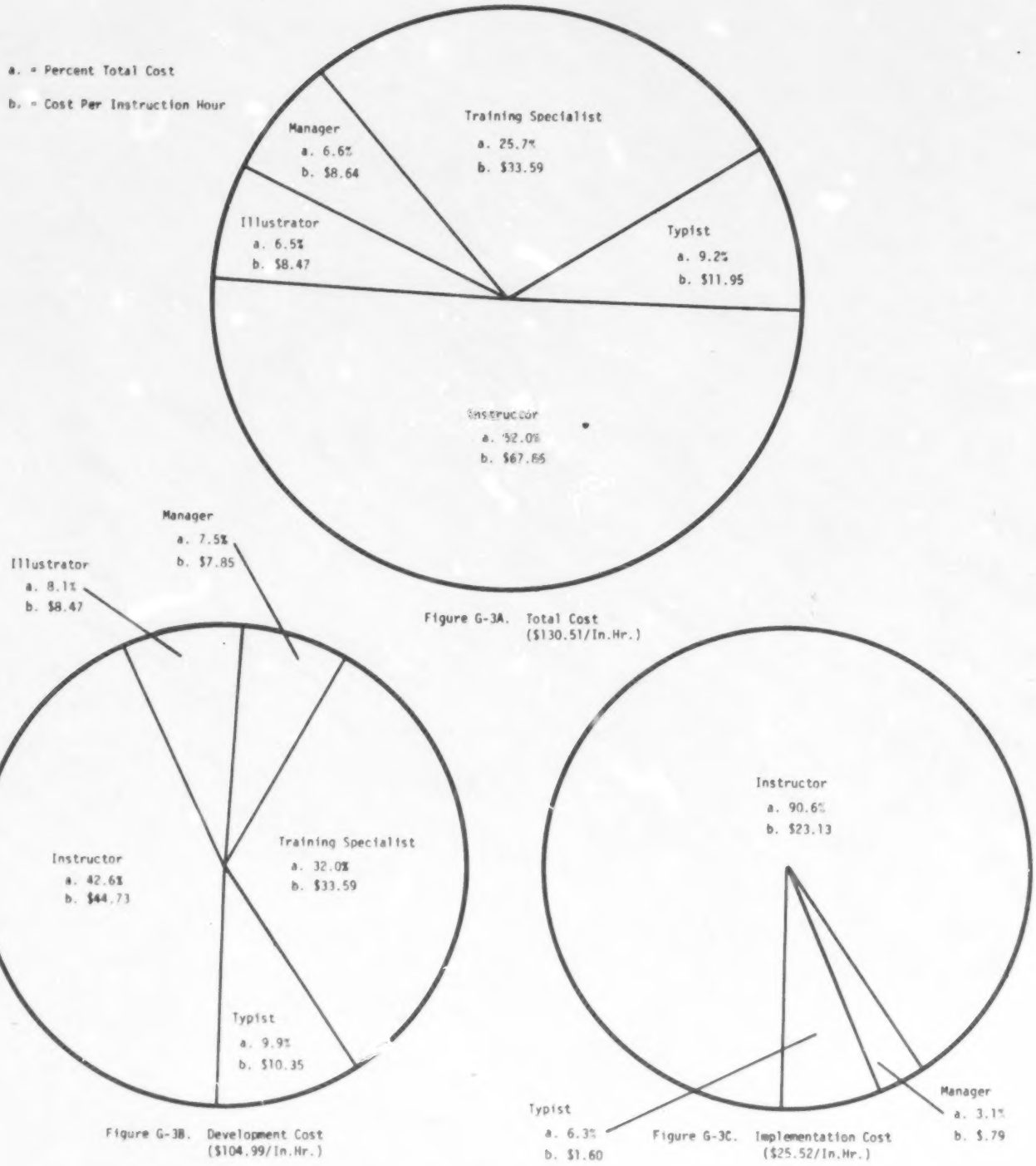

Figure G-3. Summary of CGN-38 CSMMT Labor Cost by Labor Classification

APPENDIX H

1200 PSI STEAM PROPULSION PLANT TRAINER CASE STUDY, COMPUTER TRAINING COURSE COST DATA PRESENTATION

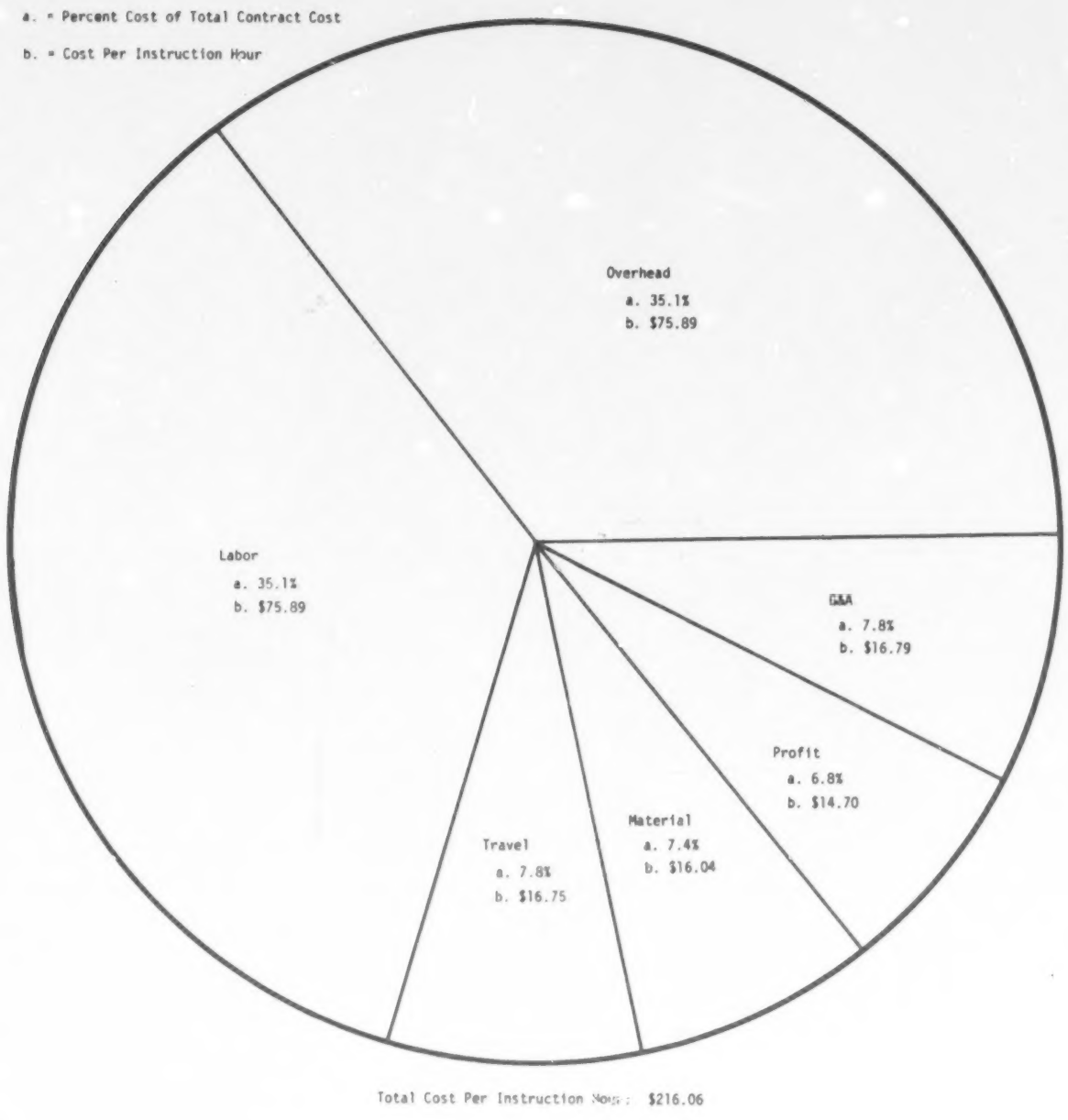

Figure H-1. 1200 PSI Steam Propulsion Plant Trainer Computer Training Course, Cost Per Instruction Hour and Percent Cost of Total Contract Cost by Major Contract Cost Category

a. Percent Total Effort

b. Labor Hours per Instructor Hour

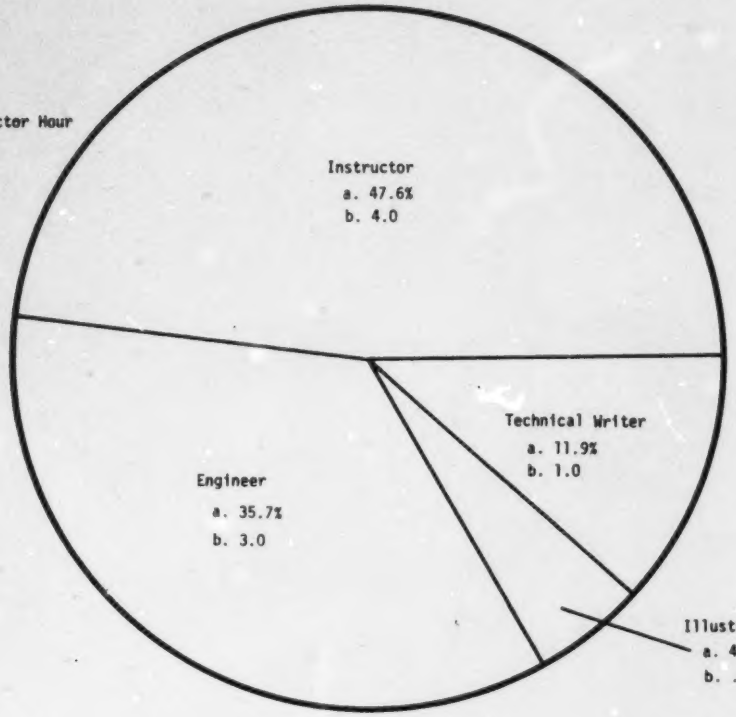

Figure H-2A. Total Labor
(8.4 Hrs./In.Hr.)

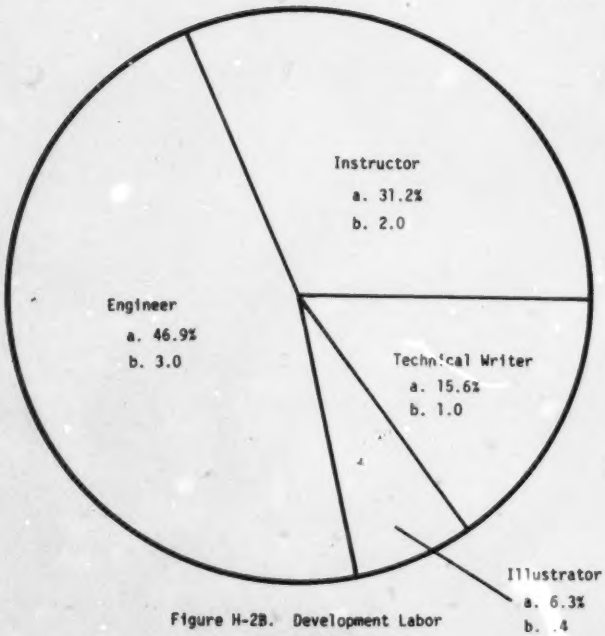

Figure H-2B. Development Labor
(6.4 Hrs/In.Hr.)

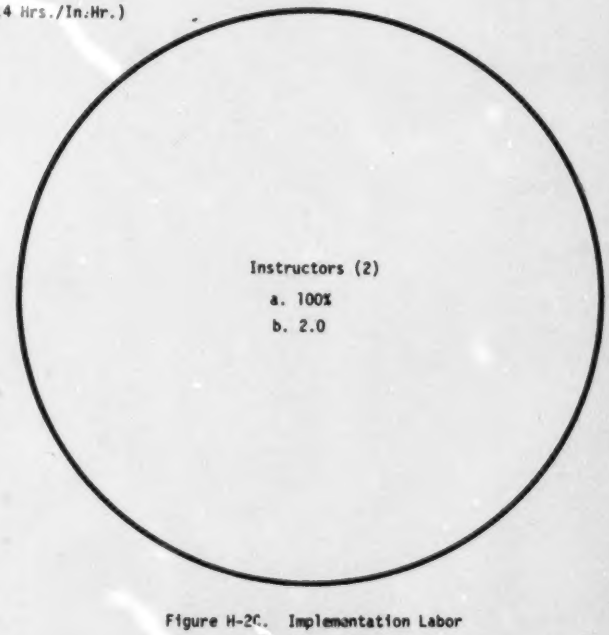

Figure H-2C. Implementation Labor
(2.0 Hrs/In.Hr.)

Figure H-2. Summary of 1200 PSI Steam Propulsion Plant Trainer Computer Training Course, Labor Effort by Labor Classification

a. Percent Total Cost

b. Cost Per Instruction Hour

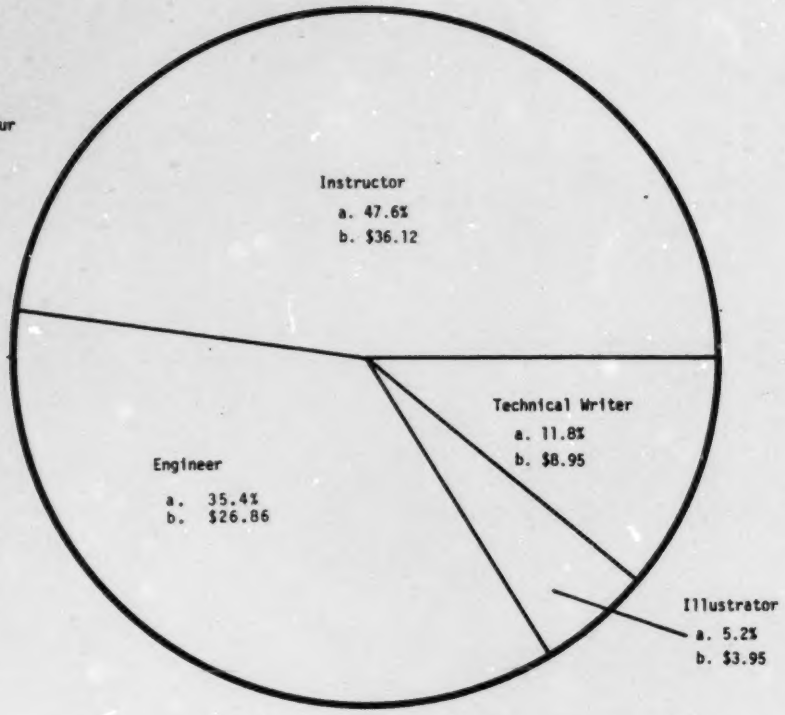

Figure H-3A. Total Cost
($75.88/In.Hr.)

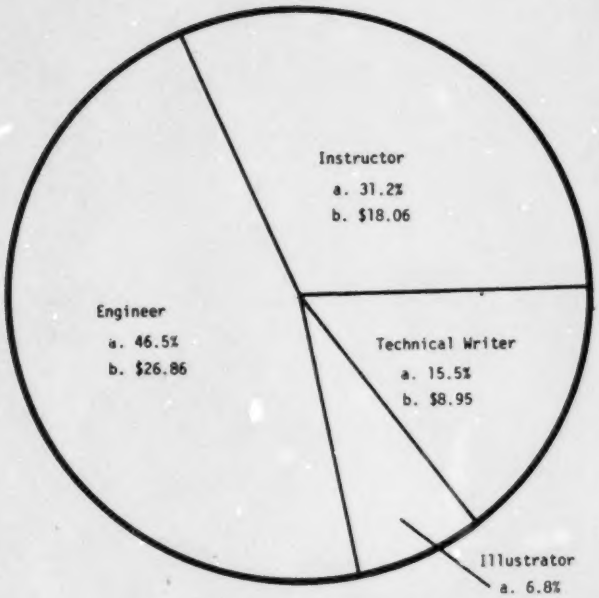

Figure H-3B. Development Cost
($57.82/In.Hr.)

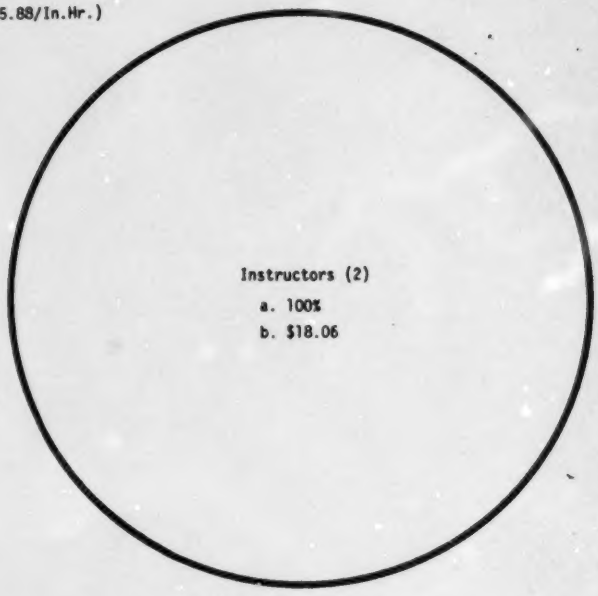

Figure H-3C. Implementation Cost
($18.06/In.Hr.)

Figure H-3. Summary of 1200 PSI Steam Propulsion Plant Trainer Computer Training Course, Labor Cost by Labor Classification

APPENDIX I

1200 PSI STEAM PROPULSION PLANT TRAINER CASE STUDY, OPERATOR/MAINTENANCE TRAINING COURSE COST DATA PRESENTATION

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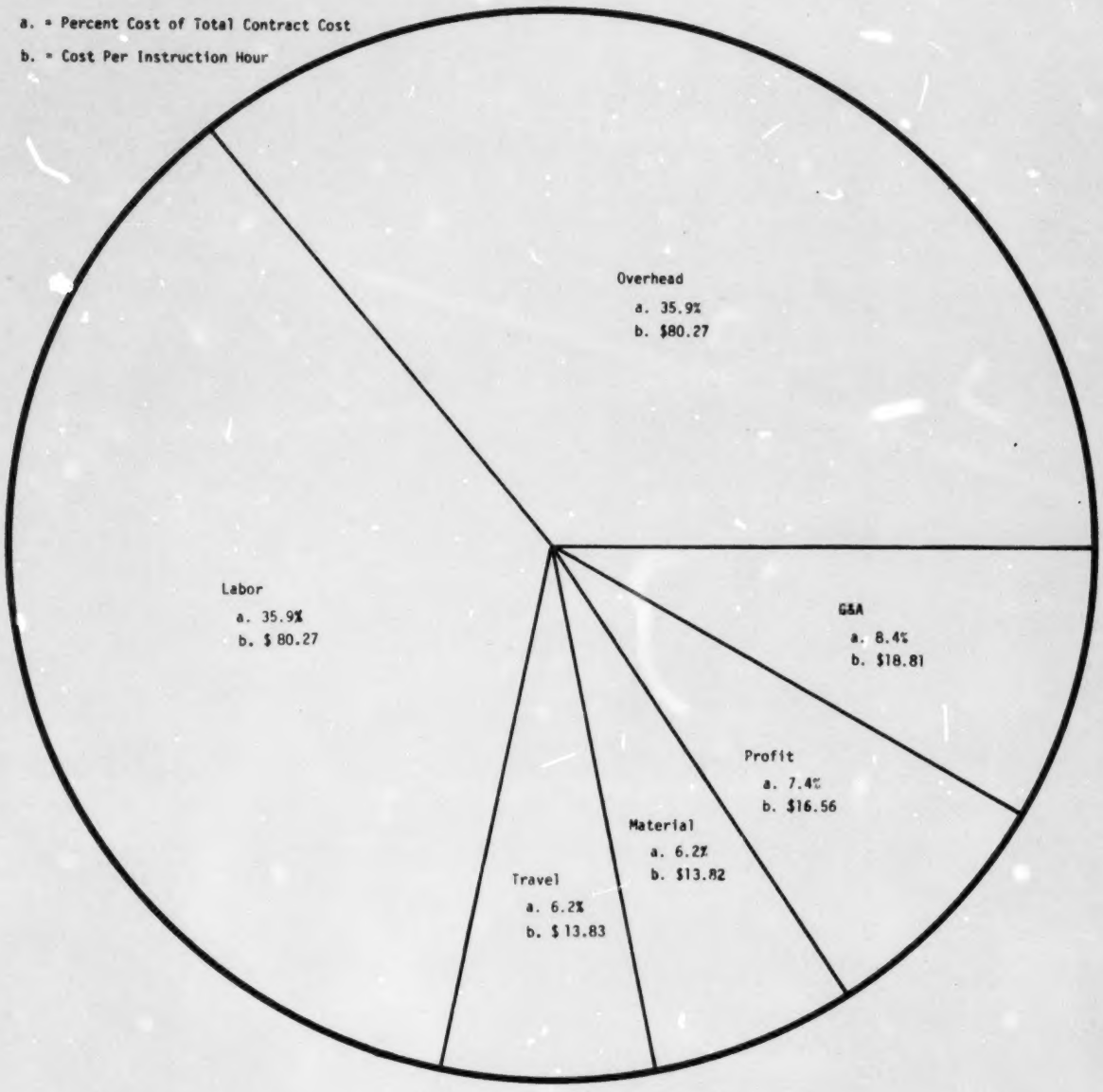

Figure I-1. 1200 PSI Steam Propulsion Plant Trainer Operator/Maintenance Training Course, Cost Per Instruction Hour and Percent Cost of Total Contract Cost by Major Contract Cost Category

a. Percent Total Effort

b. Labor Hours per Instruction Hour

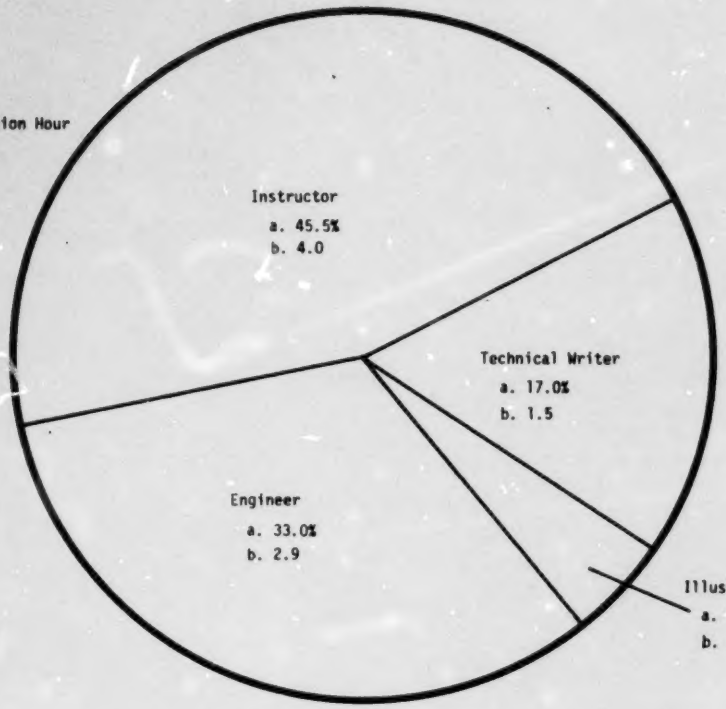

Figure I-2A. Total Labor (3.8 Hrs./In.Hr.)

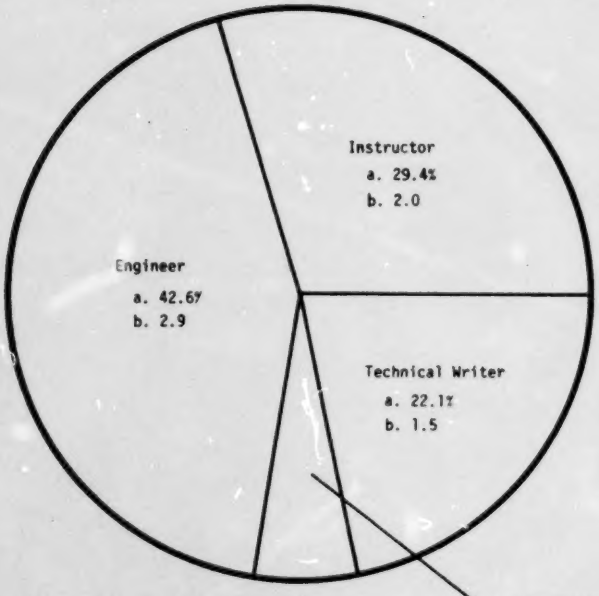

Figure I-2B. Development Labor (6.8 Hrs./In.Hr.)

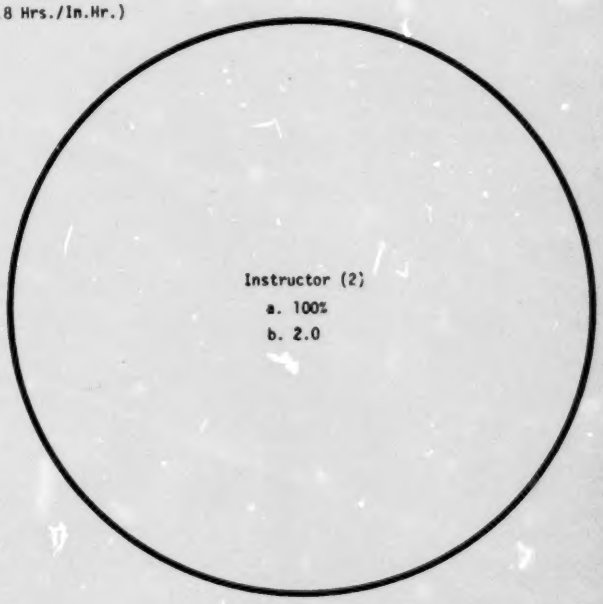

Figure I-2C. Implementation Labor (2.0 Hrs./In.Hr.)

Figure I-2. Summary of 1200 PSI Steam Propulsion Plant Trainer Operator/Maintenance Training Course, Labor Effort by Labor Classification

a. Percent Total Cost

b. Cost per Instruction Hour

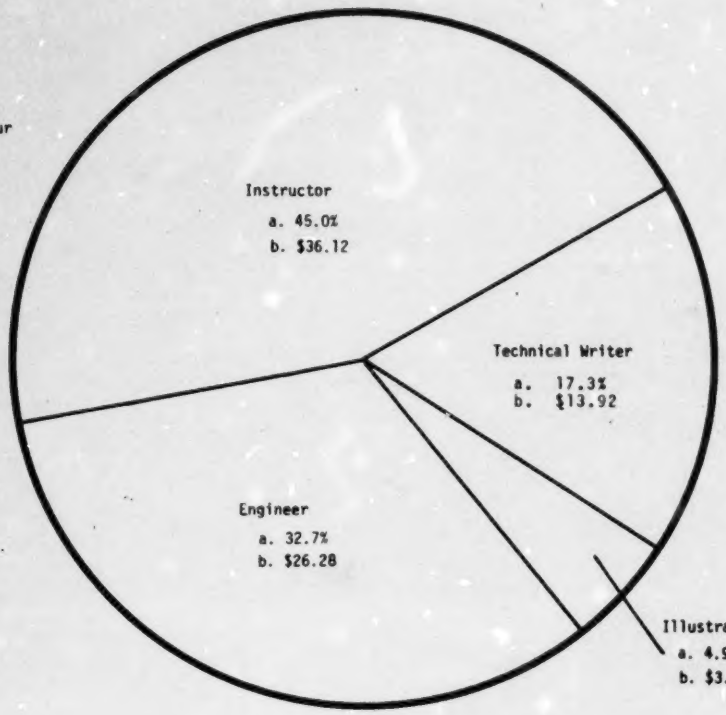

Figure I-3A. Total Cost ($80.27/In.Hr.)

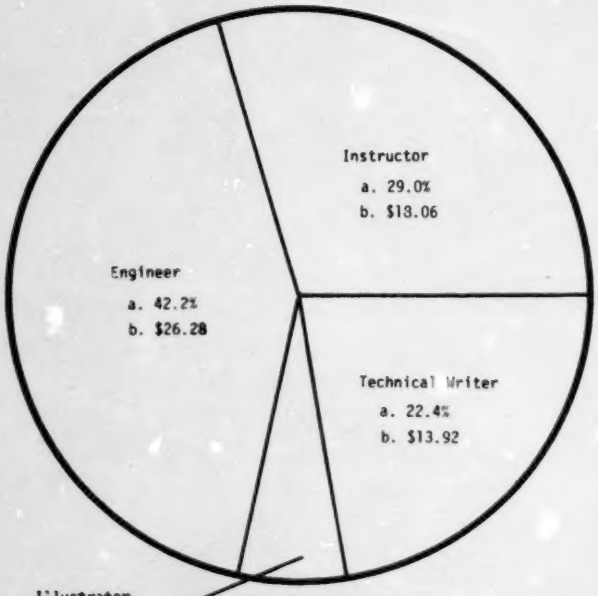

Figure I-3B. Development Cost ($62.21/In.Hr.)

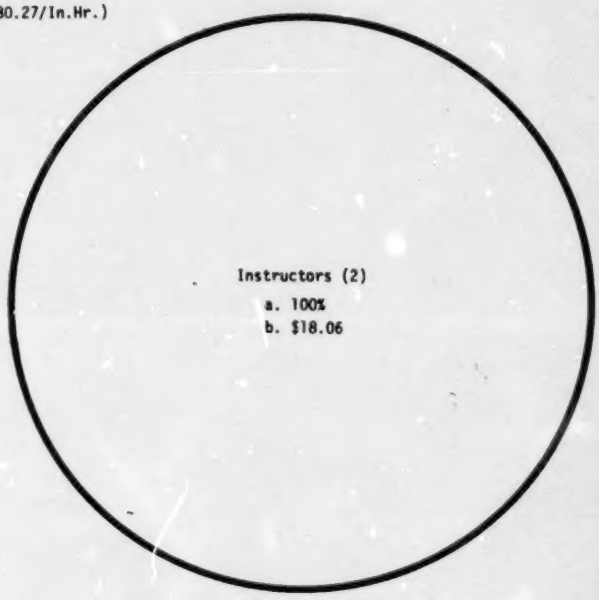

Figure I-3C. Implementation Cost ($18.06/In.Hr.)

Figure I-3. Summary of 1200 PSI Steam Propulsion Plant Trainer Operator/Maintenance Training Course, Labor Cost by Labor Classification

APPENDIX J

1200 PSI STEAM PROPULSION PLANT TRAINER CASE STUDY, INSTRUCTOR TRAINING COURSE COST DATA PRESENTATION

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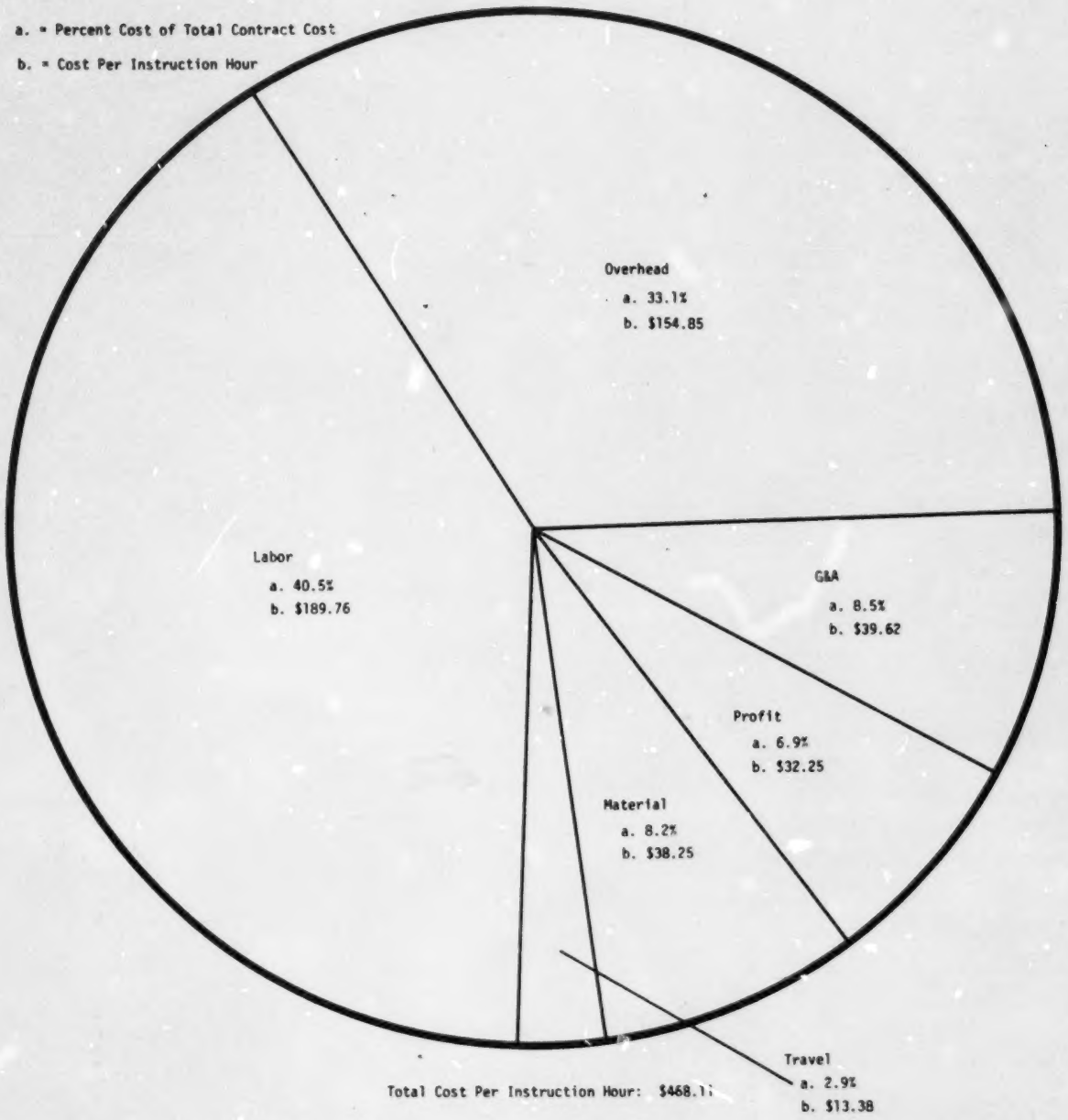

Figure J-1. 1200 PSI Steam Propulsion Plant Trainer Instructor Training Course, Cost Per Instruction Hour, and Percent Cost of Total Contract Cost by Major Contract Cost Category

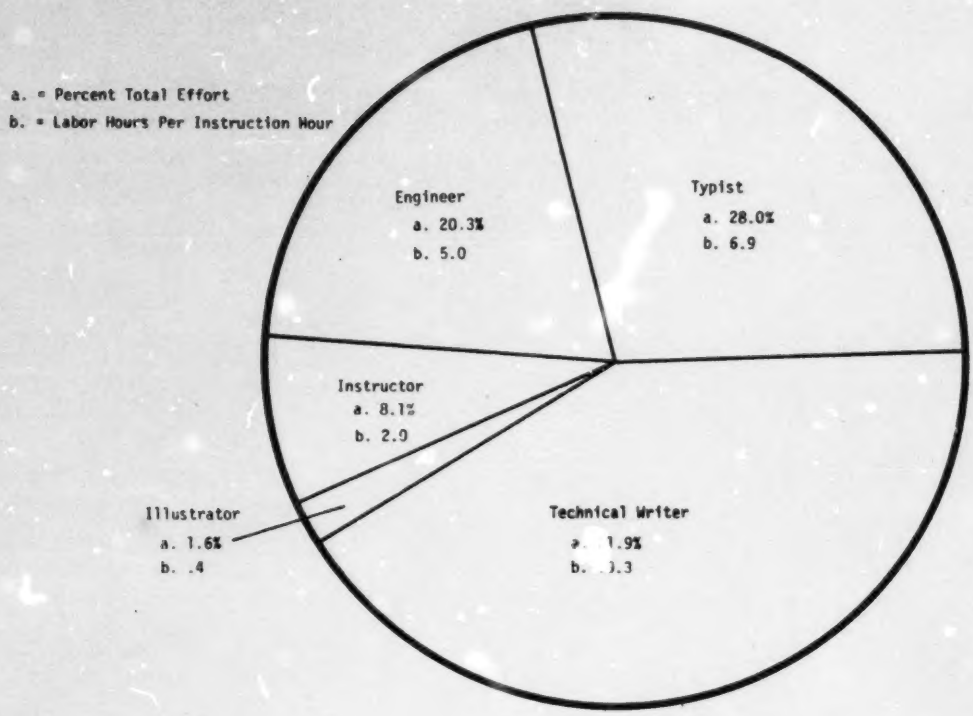

Figure J-2A. Total Labor
(24.6 Hrs/In.Hr.)

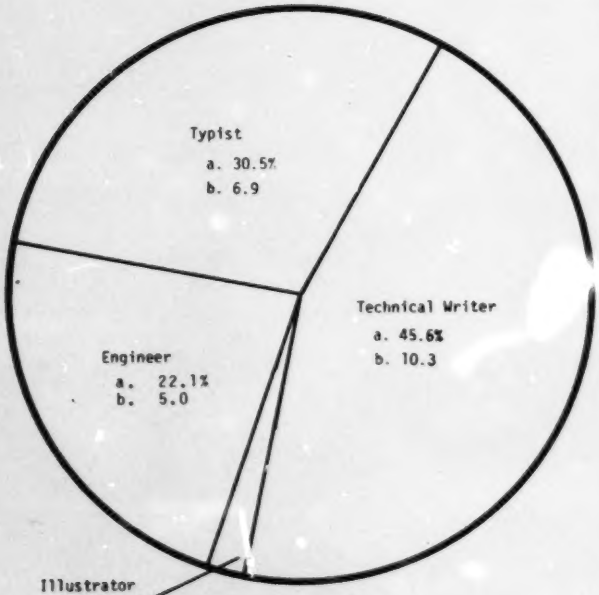

Figure J-2B. Development Labor
(22.6 Hrs/In.Hr.)

Figure J-2C. Implementation Labor
(2.0 Hrs/In.Hr.)

Figure J-2. Summary of 1200 PSI Steam Propulsion Plant Trainer Instructor Training Course, Labor Effort by Labor Classification

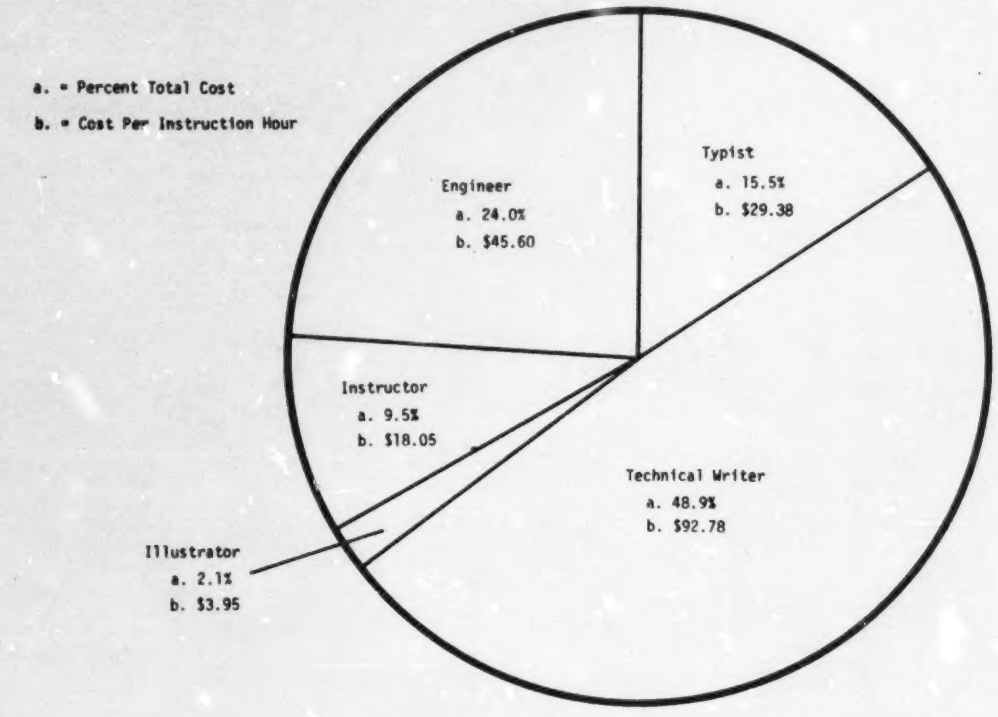

Figure J-3A. Total Cost ($189.76/In.Hr.)

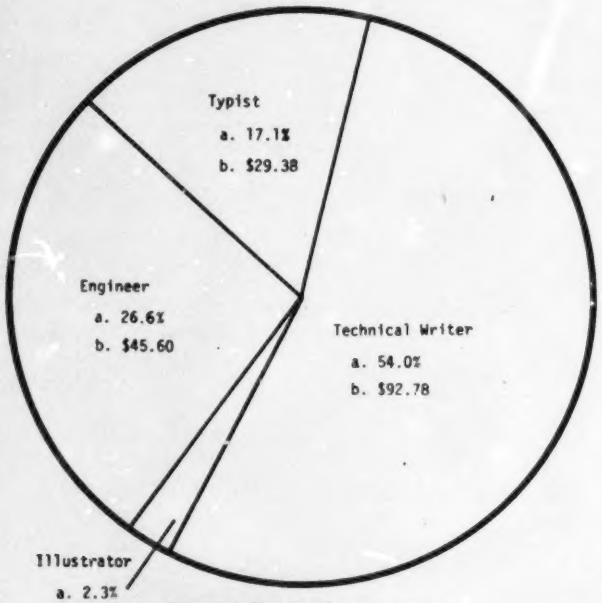

Figure J-3B. Development Cost ($171.71/In.Hr.)

Figure J-3C. Implementation Cost ($18.05/In.Hr.)

Figure J-3. Summary of 1200 PSI Steam Propulsion Plant Trainer Instructor Training Course, Labor Cost by Labor Classification

APPENDIX K

FFG-7 CENTRAL CONTROL SYSTEM CASE STUDY; MAINTENANCE TRAINING COURSE COST DATA PRESENTATION

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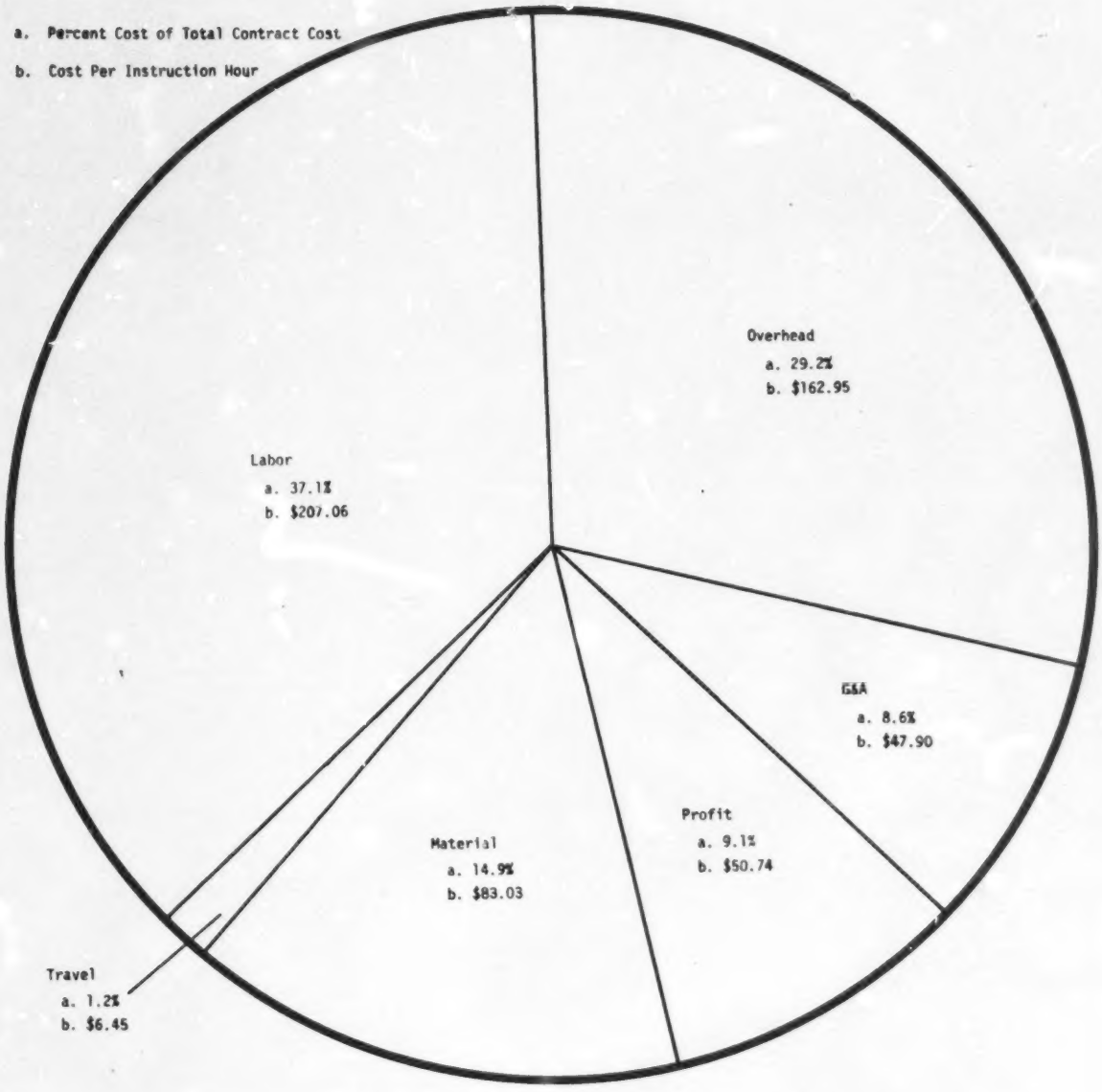

Figure K-1. FFG-7 Central Control System Maintenance Training Course, Cost per Instruction Hour and Percent Cost of Total Contract Cost by Major Contract Cost Category

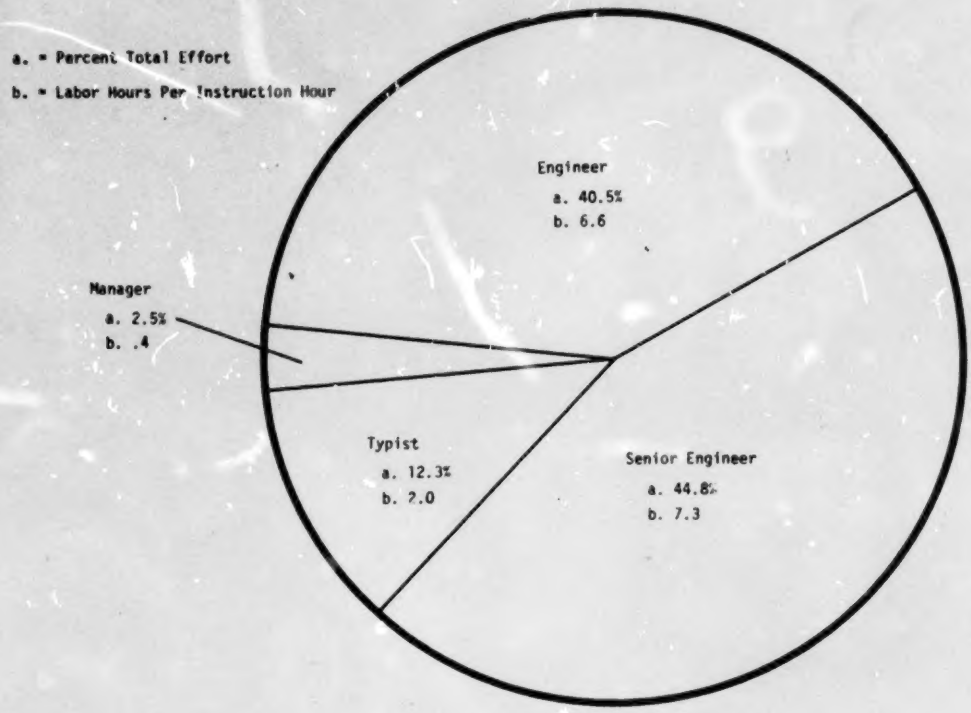

Figure K-2A. Total Labor
(16.3 Hrs./In.Hr.)

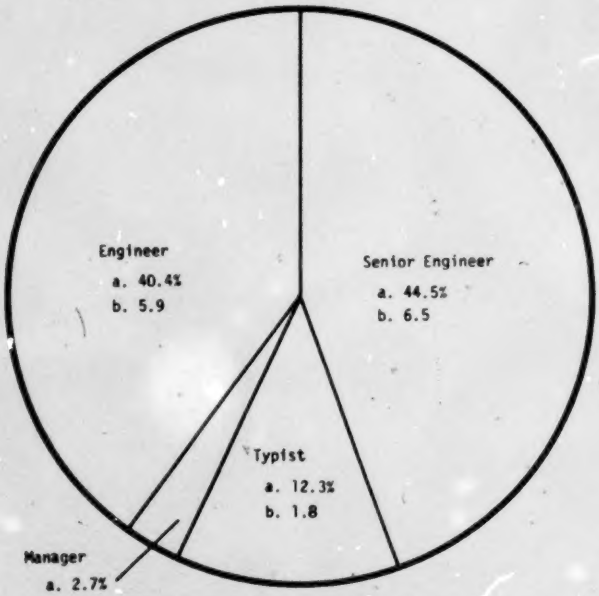

Figure K-2B. Development Labor
(14.6 Hrs./In.Hr.)

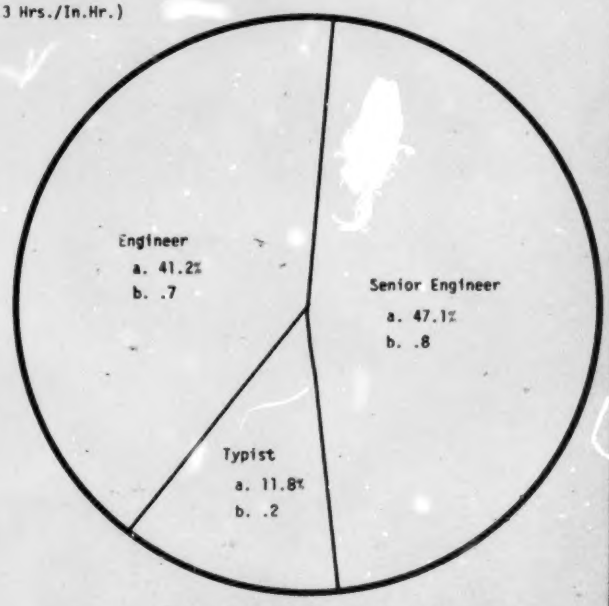

Figure K-2C. Implementation Labor
(1.7 Hrs/In.Hr.)

Figure K-2. Summary of FFG-7 Central Control System Maintenance Training Course, Labor Effort by Labor Classification

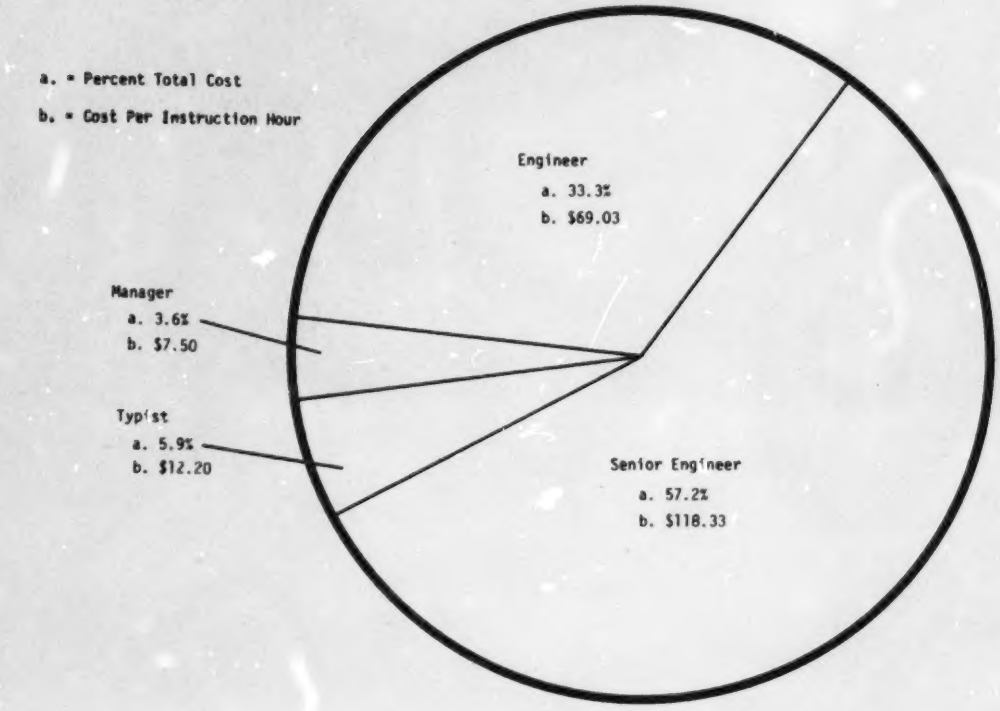

Figure K-3A. Total Cost
($207.06/In.Hr.)

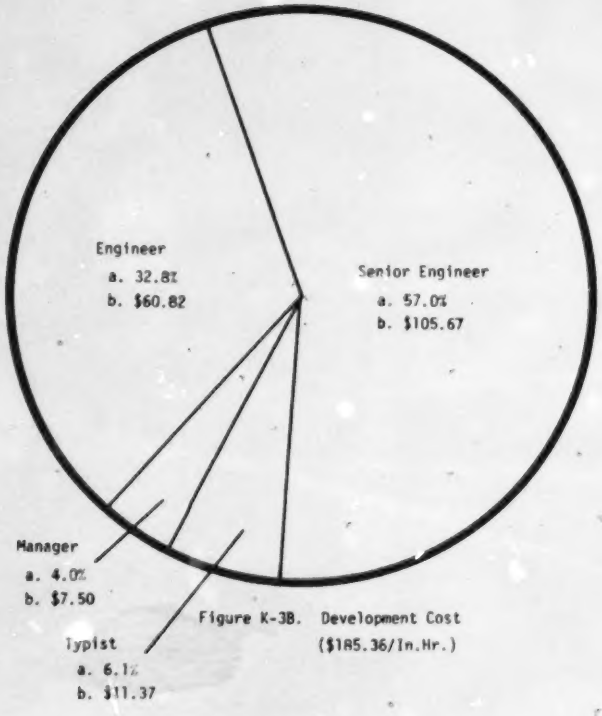

Figure K-3B. Development Cost
($185.36/In.Hr.)

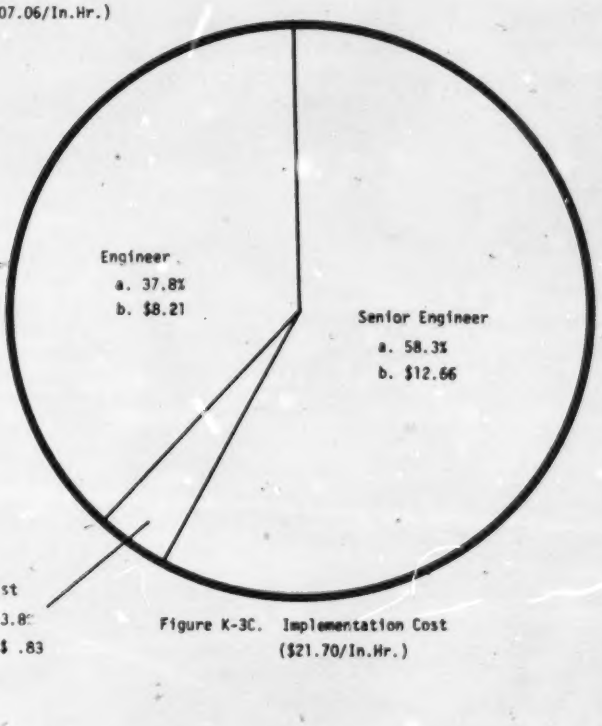

Figure K-3C. Implementation Cost
($21.70/In.Hr.)

Figure K-3. Summary of FFG-7 Central Control System Maintenance Training Course, Labor Cost by Labor Classification

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